Traditional Dairy Products

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TRADITIONAL DAIRY PRODUCTS

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"Hope" is one of god's greatest gifts to all of us.
Because
It’s the magic that inspires us to keep trying,
Learning, loving & living...

EDITOR

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All About Agriculture...
Module 1: Introduction to traditional dairy products
Lesson 1. History and developments in traditional dairy products
Lesson 2. Classification of traditional dairy products

Module 2: Khoa
Lesson 3. Khoa – Definition, varieties and standards
Lesson 4. Methods of preparation of khoa
Lesson 5. Chemical composition; factors affecting quality and yield of khoa
Lesson 6. Packaging and shelf life of khoa; defects in khoa and uses of khoa

Module 3: Khoa based sweets
Lesson 7. Peda – Product description, method of preparation, quality, packaging and shelf life
Lesson 10. Milk Cake – Product description, method of preparation, quality, packaging and shelf life

Module 4: Rabri
Lesson 12. Product description, methods of preparation, yield, packaging and shelf life

Module 5: Basundi
Lesson 13. Product description, method of preparation, yield, packaging and shelf life

Module 6: Payasam/Kheer
Lesson 14. Varieties, method of preparation, yield, packaging and shelf life

Module 7: Chhana
Lesson 15. Channa – Definition and product description, methods of preparation
Lesson 16. Preparation of chhana from buffalo milk
Lesson 17. Yield, packaging and preservation of chhana; shelf life and defects

Module 8: Chhana based sweets
Lesson 18. Rasogolla – Product description, preparation, quality, packaging and shelf life
Lesson 20. Preparation of Rasomalai, Rajbhog, Pantooa, Chhana Podo

Module 9: Paneer
Lesson 21. Product description, standards, methods of manufacture
Lesson 22. Recent developments in paneer manufacture, yield, composition, factors affecting quality, packaging and shelf life
Module 10: Fermented Dairy Products
Lesson 23. Dahi – Methods of preparation, quality, packaging, shelf life and defects
Lesson 24. Misti dahi – method of preparation, quality, packaging and shelf life, defects
Lesson 26. Shrikand – Methods of production, packaging and shelf life
Lesson 27. Lassi and Chhachh/Mattha (Country Buttermilk) – Methods of manufacture, packaging and shelf life, defects

Module 11: Miscellaneous traditional dairy foods
Lesson 28. Raita, Kadhi, Dahiwada and Raabadi

Module 12: Innovative processes for traditional dairy products
Lesson 29. Application of Membrane Technology
Lesson 30. Convenience formulations for traditional dairy products

Module 13: Microbiology of traditional dairy products
Lesson 31. Microbiological quality and safety aspects of traditional dairy products
Module 1. Introduction to traditional dairy products

Lesson 1

HISTORY AND DEVELOPMENTS IN TRADITIONAL DAIRY PRODUCTS

1.1 Introduction

Milk plays a significant role as a source of animal protein in the average Indian diet which is predominantly vegetarian. Because of higher ambient temperatures prevailing in Indian sub-continent, ancient Indians developed more stable products from milk for conservation of its nutritional goodness. So the ethnic dairy foods, commonly termed as traditional or Indian indigenous milk products, were developed over ages utilizing locally available equipment, utensils and manufacturing procedures.

1.2 Definition of Traditional Indian Dairy Products

Traditional Indian dairy products or Indian Indigenous milk products can be defined as all milk products which are native of India and which were evolved over ages utilizing locally available fuels and cooking ware.

The wide array of Indigenous milk products are poised to take strong industrial footing in the years to come with the development and application of mechanized manufacturing technologies and unit operations. A wide range of Indian milk sweets made in different parts of the country are very popular amongst all male and female, young and old population. No special event or a celebration is considered complete without serving and distributing the sweets to relatives and friends which are essentially made with the indigenous dairy products as a base.

1.3 Status, Scope & Challenges of Traditional Milk Products

Traditional Indian Dairy products are those products which are known in this country for ages. Milk and milk products formed the main food of Vedic Indians. Khoa sweets have been the item of choice for centuries in India. In early Buddhist and Jain eras, there is a mention that sweets were prepared from thickened milk named as Sihakesara and Morandeku. The rich people used to enjoy such sweets at the end of their meals. Buddha allowed his followers to carry some sweets during journeys, where it was difficult to get food stuff. In the Maurya period, the sweets were prepared from concentrated milk with the addition of honey, jaggery or sugar. In the post-Maurya period (AD 750 to 1200), milk was used in various forms. The milk was drunk when half of the quantity was evaporated. The milk was very much relished when the quantity of milk was reduced to one third of the original quantity. When milk was reduced to one-sixth of the original quantity, it was used for preparing sweets and when it was reduced to one-eighth, it was called Sarkara (Powder). The ancient medical literature states that the physical and mental happiness of individuals depend on the food they take.

India has become the largest producer of milk in the world. It produces more than 118 million tons of milk annually, as in the year 2011. Milk production in India is highly seasonal. The availability of milk is abundant after monsoons and all through the winter which is flush season, the quantity of milk in the summer declines which is lean season. It is happening over the centuries in our country. When we have too much production of any commodities without a matching demand, price come down and that is where the indigenous dairy products play their balancing role. Surplus milk in the evening is boiled and converted into dahi, then to makkhan and finally to ghee which has a shelf life of about one year.

In India only 5-6% of total milk is converted into western type of products in the organized sector. Nearly half of the milk produced in India (50-55%) is utilized for the manufacture of traditional milk products and approximately 45.7% is used as fluid milk. Only about 20% of the total milk produced is processed by the organized dairy sector. Collection of the entire surplus milk from about 5.8 lakh villages and its processing requires huge capital investment on equipments, buildings and other infrastructure. The milk that is supplied in the cities and towns is very expensive as a result of high costs of procurement, processing and packaging and due to losses because of souring of milk. Conversion of surplus milk into indigenous milk products in and
around production areas is least expensive and more profitable. A large proportion of the milk is converted into indigenous dairy products such as khoa, chhana, paneer and khoa and chhana based sweets.

1.3.1 Pattern of milk utilization in India
The milk plants in India usually receive 2.5% substandard milk due to unhygienic conditions of milk production, existence of middle man and adulteration, high ambient temperature, inadequate cooling facilities and transport arrangement and lack of appreciation for production of A grade milk. The rejection of substandard milk adversely affects the commercial interest of milk producers especially during summer. The high acid unsold milk can be profitably converted into danedar (granular) khoa for the preparation of Kalakand, Birthday cakes, Toffee and related sweets, etc. Traditional products account for over 40% of all dairy products consumed in the country. Due to lack of adequate processing and preservation methods, the manufacture and trading these products is confined to Halwais. Although authentic statistical data are not available, it is estimated that the value of Khoa and chhna based sweets if put together would be more than Rs.100, 000 million which is double the value of milk handled by the organized dairy sector.

<table>
<thead>
<tr>
<th>Table 1.1 Milk utilization pattern in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid milk/Milk products</td>
</tr>
<tr>
<td>Liquid milk</td>
</tr>
<tr>
<td>Milk powder</td>
</tr>
<tr>
<td>Ghee</td>
</tr>
<tr>
<td>Butter</td>
</tr>
<tr>
<td>Khoa</td>
</tr>
<tr>
<td>Cream</td>
</tr>
<tr>
<td>Curd (Dahi)</td>
</tr>
<tr>
<td>Ice-cream</td>
</tr>
<tr>
<td>Cheese</td>
</tr>
<tr>
<td>Others</td>
</tr>
</tbody>
</table>

1.4 Swot Analysis of Traditional Dairy Product Sector
Strengths:
• Traditional dairy products enjoy mass appeal.
• Simple manufacturing technologies which are well established for small-scale operations.
• Skilled manpower for cottage scale operations available.
• Lower cost of production and high profit margins.
• Markets are well established
• Easily available market
• Traditional dairy products require low infrastructure and operational overhead costs
• An optimistic demand profile-consumption likely to grow at an annual rate more than 20%
• Permit significant value addition, unparalleled by other dairy products
• Utilization of substandard of milk
• Use of low grade energy
• Inexpensive infrastructure and equipment
• Approimate for small scale sector
• Utilization of surplus milk.
Weaknesses:
• Lack of scientifically documented sensory, physico-chemical and microbiological profile analysis of traditional dairy products that limits standardization of processes for large-scale manufacture and design of equipments.
• Manufacturing operations are predominantly confirmed to the cottage/domestic scales.
• People involved in manufacture of traditional dairy products (Halwais) lack adequate knowledge of good hygienic practices.
• Gross lack of packaging systems that severely limit to shelf life.
• Lack of quality/legal standards and quality assurance systems.
• Regional specificity of traditional dairy product.
• Lack of production statistics based on realistic surveys provides difficulties in policy planning.

Opportunities:
• Traditional dairy product sector offers vast scope for innovation, value addition and product diversification.
• Burgeoning consumer base and greater demand due to higher purchasing power of the newly emerging middle class.
• Greater access to global market under WTO regimen.
• Expert potential to the ethnic markets.
• Opportunities exist for financing and establishing modern small scale units to encourage restructuring of unorganized sector.

Threats:
• Products prepared by scaled-up processes/new equipments may differ in sensory quality and may not find consumers acceptance.
• Modern methods of manufacture may raise production cost.

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Lesson- 2
CLASSIFICATION OF TRADITIONAL DAIRY PRODUCTS

2.1 Introduction
Indian dairy products have their distinctive characteristics as they were evolved through the ages and continuing to surprise the gourmet even today. They also aimed at conserving the nutrients of highly perishable milk for a long period.

2.2 Classification of Traditional Dairy Products
Indian indigenous milk products have different nomenclature in various regions because of the variation in the ingredients added and method of manufacture involved. For better understanding of the nature of the products, indigenous milk products can be conveniently classified into nine major categories.

2.2.1 Concentrated / partially desiccated products
In this class of products, milk is concentrated using heat energy. Moisture percent in milk gets reduced due to evaporation of vapors of the product. Based on extent of heat treatment product characteristics such as smell, colour, aroma and texture imparted to the products.
   i) Khoa
   ii) Rabri
   iii) Basundi

2.2.2 Heat and acid coagulated products
These are the coagulated products obtained upon addition of acidulant(s) to heated milk. Extent of removal of moisture controls the texture.
   i) Paneer
   ii) Chhana

2.2.3 Fermented products
Lactic cultures are used to ferment the milk at specific temperature and for specific duration. Dahi is the well known product since from ancient time and misti dahi is popular in eastern region.
   i) Dahi
   ii) Misti dahi
   iii) Chakka
   iv) Shrikhand
   v) Shrikhand wadi

2.2.4 Fat rich products
   i) Ghee
   ii) Makkhan (desi butter)
   iii) Malai

2.2.5 Frozen products
   i) Kulfi
   ii) Malai – ka – baraf
   iii) Milk – ice
2.2.6 Cereal based puddings
i) Kheer
ii) Payasam

2.2.7 Indian milk confections
2.2.7.1 Khoa based sweets
i) Gulabjamun
ii) Burfi
iii) Kalakand
iv) Milk cake etc.

2.2.7.2 Channa based sweets
i) Rasogolla
ii) Rasomalai
iii) Sandesh etc.

2.2.7.3 Chhana and khoa based sweets
i) Kala-Jamun
ii) Pantooa

2.2.7.4 Miscellaneous milk sweets
i) Milk agar cake
ii) Colostrum pudding

2.2.8 Refreshing beverages
i) Lassi
ii) Chhachh
iii) Raabadi

2.2.9 Miscellaneous products
i) Kadhi
ii) Raita
iii) Dahiwada

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Lesson 3
KHOA – DEFINITION, VARIETIES AND STANDARDS

3.1 Introduction
Among the indigenous milk products, khoa occupies a prominent place as it forms a base for number of sweet delicacies. Khoa is a popular product throughout India and is called by different names in different regions like khoya, mawa, kava, palghova, etc.

3.2 Definition of Khoa
Khoa is a concentrated whole milk product obtained by open pan condensing of milk under atmospheric pressure.

According to Food Safety and Standard Regulations 2011, Khoya, by whatever variety of names it is sold such as Pindi, Danedar, Dhap, Mawa or Kava, means the product obtained from cow or buffalo or goat or sheep milk or milk solids or a combination thereof by rapid drying. The milk fat content shall not be less than 30 percent on dry weight basis of finished product. It may contain citric acid not more than 0.1 percent by weight. It shall be free from added starch, added sugar and added colouring matter.

Table 3.1 Microbial standards of khoa given by FSSAI

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Khoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total plate count</td>
<td>Not more than 50000/g</td>
</tr>
<tr>
<td>Coliform count</td>
<td>Not more than 90/g</td>
</tr>
<tr>
<td>E. coli</td>
<td>Absent in 1 g</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Absent in 25 g</td>
</tr>
<tr>
<td>Shigella</td>
<td>Absent in 25 g</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>Not more than 100/g</td>
</tr>
<tr>
<td>Yeast and mold count</td>
<td>Not more than 250/g</td>
</tr>
<tr>
<td>Anaerobic spore count</td>
<td>Absent in 1 g</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>Absent in 1 g</td>
</tr>
</tbody>
</table>

According to Bureau of Indian standards, khoa is a heat coagulated milk product obtained by partial dehydration of milk of buffalo, cow, sheep and goat or their admixture. It shall not contain any ingredient foreign to milk except addition of citric acid in Danedar khoa.

Table 3.2 BIS standards of khoa

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pindi</th>
<th>Danedar</th>
<th>Dhap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids % by mass (min)</td>
<td>65.0</td>
<td>60.0</td>
<td>55.0</td>
</tr>
<tr>
<td>Fat % by mass (on dry matter basis)</td>
<td>37.0</td>
<td>37.0</td>
<td>37.0</td>
</tr>
<tr>
<td>Total ash (% on dry matter basis)</td>
<td>6.0</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Titratable acidity % (max)</td>
<td>0.8</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Coli form count /g (max)</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Yeast and mould count /g (max)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

BIS specifications are not mandatory, but suggestive of acceptance levels.
3.3 Varieties of Khoa
There are three distinct varieties of khoa. They differ in their composition, body and textural characteristics and end use.

3.3.1 Pindi
This variety is identified as a circular ball of hemispherical pat with compact mass, homogenous and smooth texture. It shall not show any sign of fat leakage or presence of free water. It possesses pleasant cooked flavour and devoid of objectionable tastes like burnt, acidic, etc. This variety of khoa is used in the manufacture of burfi, peda and other varieties of sweets.

3.3.2 Dhap
It is a raw (katcha) khoa characterized by loose but smooth texture and soft grains and sticky body. Dhap variety carries highest percentage of moisture over other varieties of khoa. This high moisture is necessary to provide adequate free water for soaking of maida (refined wheat flour) and semolina (suji) and for homogenous distribution of other ingredients in the preparation of smooth gulabjamun balls. This variety of khoa is used in the manufacture of gulabjamun, kalajamun, pantooa, carrot halwa, etc.

3.3.3 Danedar
This is characterized by the granular texture with hard grains of different sizes and shapes embedded in viscous serum. Slightly sour milk is preferred in the manufacture of this variety as it yields granular texture. This variety of khoa is used in the manufacture of kalakand, milk cake, etc.

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Lesson 4

METHODS OF PREPARATION OF KHOA

4.1 Introduction
Khoa is prepared by different methods depending on the location and quantity of milk available for conversion. Khoa is manufactured by the following four basic methods viz. traditional method, improved batch method, mechanized method and use of membrane technology.

4.2 Traditional Method
Generally buffalo milk is preferred for manufacture of khoa as it results in higher yield, smooth texture and soft body with sweet taste. Where buffalo milk is not available, cow milk is used for khoa making but it results in pasty body and slightly saltish taste due to higher chlorides in the product.

4 liters of buffalo milk or 5 liters of cow milk which approximately yields 1 kg khoa is used per batch. Filtered milk is taken in a heavy bottomed wide mouth iron pan (karahi) and boiled on a brisk non–smoky fire. An iron scraper (khunti) is used for stirring the milk during boiling and also to scrap the milk film forming on the surface during boiling. A rapid stirring and scraping is carried out through out boiling to facilitate quick and rapid evaporation of water from milk and also to prevent scorching of milk film on surface. Due to continuous evaporation of water, the milk progressively thickens. The researchers have observed that at 2.8 fold concentration of cow milk and 2.5 fold concentration of buffalo milk, heat denaturation of milk proteins takes place and the proteins will not go into solution again. The heating is continued till the milk thickens considerably and at this stage heating is reduced and speed of stirring and scraping is increased to obtain good quality product. If the milk is subjected to high heat treatment with less stirring and scraping at this stage it results in dark colored khoa that does not fetch a good price in the market as white/cream colored khoa is preferred for sweets making.

As the concentration is progressing, the product slowly tends to leave the sides of the pan and starts’ accumulating at the bottom and at this stage; the pan has to be removed from the fire. The contents are worked up and the residual heat of the vessel helps in further evaporation of moisture. The contents are transferred to the non corrosive metal moulds and allowed to cool.

There are several limitations of this method such as:

1) Time and labor consuming
2) Large variation in quality
3) Poor keeping quality
4) Small scale production
5) Smoky smell

4.2.1 Production of Three Varieties of Khoa
4.2.1.1 Dhap
For preparing dhap variety of khoa, the heating should be stopped at rabri stage (thick mass) and leaving the product without much working which carry soft grains and high moisture content.

4.2.1.2 Pindi
For production of pindi variety of khoa, heating is continued after rabri stage and with the help of a wooden ladle the soft grains are crushed and the mass is worked up to a smooth textured product. khoa is molded in to hemispherical molds to give its shape, and allowed to cool.
4.2.1.3 Danedar

Generally the milk that is left over after the preparation of other varieties of khoa during the day develops acidity which is converted into danedar variety of khoa. Sometimes citric acid (0.05 to 0.1%) or sour whey is added to milk at boiling stage to get granular texture.

4.3 Improved Batch Method

A stainless steel double jacketed, steam heated pan or kettle is used to provide greater control on the heating process and to ensure a non smoky heating. Five liters of standardized cow milk with 4.5% fat or four liters of standardized buffalo milk with 5.5% fat is taken per batch and milk is brought to boil in the kettle. During boiling, bottom and the surfaces of the kettle are scraped and milk is stirred vigorously by a stainless steel stirrer to avoid burning of milk solids. About 2 kg/cm² pressure is used for boiling milk. When the milk attains a rabri stage, slow heating is necessary at this stage to prevent burning of solids on the surface, discoloration of the product, development of burnt flavour and hard body and coarse texture. The rate of stirring should be increased during last stages to obtain good quality product. As soon as the product shows signs of leaving the sides of the kettle and accumulates in the centre in a pat form, heating is stopped. It takes about 15 - 20 min to prepare a batch of khoa (1 kg approx) by this method.

As steam will not be available at village level the above method has its application only in dairies having steam production lines. However a village level khoa pan was developed to overcome the above problem. The set up consists of hemispherical mild steel pan joined to a cylindrical jacket. Water is taken in the outer jacket and heated by placing the whole unit over a Chullah. Steam is generated in the jacket and the pressure is indicated by a gauge. The milk is taken in the steel pan and heated by the steam and after loosing the latent heat, returns to water phase. Water in liquid and vapour form exists in phase equilibrium at adjusted pressure because of the closed system. Good quality khoa can be prepared in the pan from 2.5 litre milk in 8 min.

4.4 Mechanized Processes for Khoa Production

4.4.1 The first continuous khoa making machine

A continuous khoa making machine was developed which consists of a preheating cylinder and two cascading pans. The preheater is a steam jacketed cylinder containing rotary scrapers which rotate at 120 rpm. The cascading pans are covered steam jacketed pans with open holes provided with spring loaded reciprocating type scraper knives operating at 30 strokes per min. The milk is taken into the preheater and heated by steam at 3 kg/cm² pressure. Here the milk is concentrated to about 30 to 35 per cent of total solids within 10 to 12 min. From the preheater, the milk enters the first cascading pan. Here the milk is further concentrated to about 50 to 55 per cent total solids within 7 to 8 min. The product then moves to the second cascading pan where its concentration is raised to the desired level i.e., 65-70 percent in 6 to 7 min. The steam pressures maintained in the two pans are 2 kg in this machine. The steam requirement is 50kg/cm² and electric power requirement is 4 KW per hour.

4.4.2 Use of roller drier

A roller drying process was adopted in the preparation of khoa. Process variables such as steam pressure, flow rate and distance between rollers and scrapers were adjusted to get the desirable product. Vacuum concentrated milk with 50% T.S. was heated to 74ºC for 10 min to develop cooked flavour in khoa. Steam at a pressure of 25-30 psi and roller speed of 17-19 rpm gives good results. It was concluded that satisfactory khoa can be prepared on drum driers using 50% T.S. vacuum concentrated milk. The concentrate is preheated to 101 to 103ºC for 10-12 min to develop cooked flavour on drums with steam pressure of 0.7 to 1 kg/cm² and a roller speed of 10 rpm.

Limitations:
1) Losses in the beginning is high
2) Uneven product
3) Lacks grainy texture
4) Need careful monitoring during working
5) Difficult to maintain constant steam pressure
(If more steam dried product will come and if less steam liquid product)

4.4.3 Use of scraped surface conical vat
Attempts have been made to use scrapped surface heat exchangers in the preparation of khoa. A mechanized scraped surface heat exchanger with a conical vat process is developed for the production of khoa. Forty kg concentrated or 80 kg whole milk can be taken per batch which takes about 14 min and 50 min respectively. Steam pressure used is 1.5 kg/cm$^2$. Product losses are high in this machine.

![Fig. 4.1 Conical vat for khoa making developed at NDRI](image)

4.4.4 Contherm–Convap system
Attempts were made to prepare khoa on Contherm-Convap system which was developed by Alfa-Laval. This unit consists of two parts, a Contherm for heating the feed to about 95°C and Convap for concentrating milk to desired milk solids level. Concentrated milk with 35-40% T.S. at the rate of 300-350 kg per hour can be fed to the machine. The steam pressures employed are 3 kg/cm$^2$ in Contherm and 4 kg/cm$^2$ in Convap.

![Fig. 4.2 Contherm–Convap system (Alfa Laval)](image)
Limitations:
1. Lacks typical khoa flavour
2. Sticky, pasty and burnt particles
3. Lacks grainy texture and uneven colour
4. Inconsistent product quality
5. High loss of milk solids in the beginning (Due to lot of adjustments required in the initial stage of operation).

4.4.5 Thin film scraped surface heat exchanger (TSSHE)
A horizontal heat exchanger for khoa making was developed which consists of a hopper to accommodate the foam and provide milk concentration under atmospheric pressure. In this model, the steam jacket is subdivided into three parts to reduce the amount of heating as the product moves. The scraper speed is 40 rpm and the steam pressure maintained is 3 kg/cm² in the first compartment which is step wise reduced to 1.5 kg/cm² in the last compartment. The machine can convert 50 kg of milk into khoa per hour per batch. A continuous khoa making machine with three stage concentration has been developed. The machine has three jacketed cylinders placed in a cascade arrangement. This facilitates easy transfer of milk from one cylinder into the other. The scraper speeds are 40, 55 and 69 rpm for the first, 2nd & 3rd stage respectively. The operating steam pressures used are 2.0 & 1.7 & 1.5 kg/cm² in respective stages. One roller is used in the last stage in place of scraper blade which kneads the khoa to improve its body and texture. The first stage raises the milk solids level from initial 15 to 25 percent, the second stage to 50 percent and the third stage to 65-70 percent. The machine converts 50 kg of milk into khoa per hour at the operating pressures, specified. However, the capacity depends on the milk flow rate, steam pressure, total solid concentration of feed and final moisture required in the product. It is claimed that use of concentrated milk improves the capacity of the machine.

4.4.6 Inclined scraped surface heat exchanger (ISSHE)
An inclined scraped surface heat exchange for continuous khoa making was developed. A scraper assembly is so built as to combines the functions of scraping and conveying. The SSHE has 3 jackets which operate at 1.0, 1.5 and 1.0 kg/cm³ respectively. Milk is previously vacuum pre-concentrated to 40 - 55% T.S and fed at the rate of 60-80 lit/hr. Feed temperatures between 10 – 80 °C can be employed. Rotor speed used is 40 to 80 rpm. The advantages claimed by this unit are:

• Increased solids content in feed improves the colour of khoa because of reduced residence time. It also improves the capacity of the machine.
• Increase in feed temperature enhances the production capacity of the plant.
• By increasing rotor speed, there will be significant increase in the heat transfer rate.
• Variation in steam pressure in separate sections of steam jacket results in change of heat transfer rate, colour and texture of khoa due to change in the temperature to which the milk constituents are subjected to different stages of khoa making.
• The man power requirements are reduced.

Fig. 4.3 Inclined scraped surface heat exchanger (ISSHE) (Source: NDDB)
Advantages of the ISSHE
1) As the khoa making is continuous process it is possible to maintain uniform quality for khoa throughout the production run.
2) There are minimum operational losses.
3) The equipment gives flexibility to change the characteristics of khoa as per the requirement of the product formulations.
4) It is easy to go in for automation so that the entire khoa making process can be monitored by a microprocessor.
5) The plant is suitable for ‘in place cleaning’.
6) The man power requirements are less compared to that of batch method.
7) Due to small hold up raw material in the plant at any point of time there is no chance of whole batch getting spoiled.
8) Permits quick start up and close down.
9) Milk flows in enclosed system, thus permitting freedom from environment contamination.

Limitations
It requires concentrated milk as a feed which is available only in organized dairies. Hence the unit is not suitable in the situation where concentrated milk is not available.

4.5 Chemical Quality of Khoa
Wide variations exist in chemical quality of cow and buffalo milk khoa.

<table>
<thead>
<tr>
<th>Constituent (%)</th>
<th>Cow-milk Khoa</th>
<th>Buffalo-milk Khoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>30.93</td>
<td>22.34</td>
</tr>
<tr>
<td>Total solids</td>
<td>69.07</td>
<td>77.66</td>
</tr>
<tr>
<td>Fat</td>
<td>22.00</td>
<td>32.20</td>
</tr>
<tr>
<td>Proteins</td>
<td>19.10</td>
<td>17.70</td>
</tr>
<tr>
<td>Lactose</td>
<td>24.10</td>
<td>23.70</td>
</tr>
<tr>
<td>Ash</td>
<td>3.72</td>
<td>3.71</td>
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</tbody>
</table>

The market samples of khoa show wide variations in chemical composition. Certain times, the market samples fail to meet the minimum legal standards. To provide minimum legal standards in khoa, the minimum fat content of 4.4% in cow’s milk and 5.5% in buffalo milk should be maintained.
Lesson 5
CHEMICAL COMPOSITION; FACTORS AFFECTING QUALITY AND YIELD OF KHOA

5.1 Introduction
Khoa contains fairly large quantities of muscle building proteins, bone forming minerals and energy giving fat and lactose. It has got, in concentrated form, most of the fat soluble vitamins and many water soluble vitamins contained in the original milk.

5.2 Chemical Composition of Three Varieties of Khoa

Table 5.1 Average Chemical composition of three varieties of khoa (on product basis)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Pindi</th>
<th>Dhap</th>
<th>Danedar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids</td>
<td>65.0</td>
<td>56.0</td>
<td>61.5</td>
</tr>
<tr>
<td>Fat</td>
<td>22.5</td>
<td>19.4</td>
<td>20.9</td>
</tr>
<tr>
<td>Proteins</td>
<td>19.5</td>
<td>17.1</td>
<td>18.4</td>
</tr>
<tr>
<td>Lactose</td>
<td>19.4</td>
<td>16.7</td>
<td>18.9</td>
</tr>
<tr>
<td>Ash</td>
<td>3.5</td>
<td>2.9</td>
<td>3.4</td>
</tr>
</tbody>
</table>

The fat content in all the three varieties shall not be less than 30 percent on dry matter basis as per FSSA rules.

Table 5.2 Physical quality of cow and buffalo khoa

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Cow</th>
<th>Buffalo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Pale yellow to slight brown</td>
<td>Whitish to light cream tinge</td>
</tr>
<tr>
<td>Appearance</td>
<td>Moist surface</td>
<td>Tinge</td>
</tr>
<tr>
<td>Body</td>
<td>Slightly hard</td>
<td>Oily or greasy surface</td>
</tr>
<tr>
<td>Texture</td>
<td>Slightly open</td>
<td>Smooth, Soft, Slight granular</td>
</tr>
<tr>
<td>Odour</td>
<td>Rich, nutty</td>
<td>Nutty rich</td>
</tr>
<tr>
<td>Taste</td>
<td>Slightly salty</td>
<td>Sweet</td>
</tr>
</tbody>
</table>

5.3 Yield of Khoa
Generally 4 kg of buffalo milk or 5 kg of cow milk yield one kg of khoa. The yield of khoa depends on the following factors:

5.3.1 Type and quality of milk
Buffalo milk gives more yield than cow milk because of its higher fat and solids. Adulterated milk and low solids milk give lower yields.

5.3.2 Moisture content in khoa
Higher the moisture content in khoa, higher the yield and vice versa. The yield of dhap variety of khoa is more than Pindi variety of khoa because of higher moisture content.

5.3.3 Losses during handling
Higher losses due to stickage of product and milk spillage losses during processing which will result in lower yields.
5.4 Factors Affecting Quality of Khoa

Higher amount of free fat (>60%) gets released in buffalo milk khoa than cow milk khoa. Higher free fat content contributes to soft body and oily or greasy appearance to buffalo milk khoa. Fresh milk is usually preferred for production of good quality khoa suitable for making sweets. Good quality khoa should have either a light yellow (if made from cow milk) or a dull white colour if made from buffalo milk), slightly heated flavour, but free from oiliness and acidic taste, smooth body and a compact mass of very small uniformly sized grains. It should not have visible water droplets or show sign of oozing of fat. When fresh should be able to produce a smooth homogenous paste on working, which indicates that it is suitable for sweet making.

5.4.1 Quality of milk

In India both cow and buffalo milks are used for manufacture of traditional dairy products depending on the availability and suitability of milk for a particular product. However, the quality of the products greatly depends on the type of milk used for their preparation. Yield of Danedar is and Dhap type of Khoa from buffalo milk is 24% and 25%.

a) **Species of Animal**: Buffalo milk is preferred over cow milk for khoa making because it yields a product with soft, loose body and smooth granular texture which is highly suitable for the preparation of sweets. The buffalo milk gives a greater out burn than that from cow milk. The average yield from buffalo milk is 21.6-23% and from cow milk it is 18.3-18.5% due to the higher T.S. Content in buffalo milk moisture content in khoa. Khoa from cow milk is of inferior quality due to its dry surface, sticky and sandy texture and salty taste (due to higher chloride and citrate content (Citrate buffalo milk 0.18%, cow milk 0.18% and chloride: buffalo milk 0.07% and cow milk 0.10%)) which is not considered suitable for manufacturing of best quality khoa based sweets.

b) **Fat content in milk**: A minimum fat level of 4% in cow milk and 5.5% in buffalo milk is essential for production of khoa with desirable body and texture and to meet the FFA requirements also. A lower fat content results in undesirable hard body and coarse texture in the finished product which is not suitable for good quality sweets preparation. The fat level higher than the minimum improves the quality of the final product. (The higher emulsifying capacity of buffalo milk fat due to the presence of higher proportion of butyric acid containing triglycerides (50%) than only 35% in cow milk fat and higher fat content in buffalo milk is responsible for smooth and mellowy texture of buffalo milk khoa)

c) **Acidity of milk**: Fresh sweet milk yields the best quality khoa, while developed acidity in milk produces an undesirable, coarse texture sour smell and bitter taste in to the khoa which is unsuitable for sweet preparation.

d) **Presence of additives and adulterants**: Neutralization of high acidic milk improves the texture, but does not improve the flavour of khoa. Further it gives saltish taste in the final product.

1. Presence of colostrum in milk has a marked effect on the colour of khoa, which is deep yellow with cow colostrums. It also gives pasty texture in the final product making it not suitable for sweet making. Adulteration of milk with water produces a brown khoa and a proportionate reduction in the yield. Texture and flavour of khoa are not affected much when adulterated with starch the physical quality of khoa is considerably affected. It develops a harder body and a pasty sticky texture not suitable for the preparation of confections.
2. Speed of Stirring: The speed of stirring should be optimum. It depends on the type of machine/ method. In case of traditional method the optimum speed is about 100 rpm where as in continuous systems it depends upon the type of machine used (it is slightly more). The optimum speed of stirring prevents burning of milk solids and helps in developing desirable body and texture in khoa. Low speed results in to the burning of khoa. Higher speed makes the product pasty and sticky.

3. Temperature of desiccation: To obtain good quality khoa, milk should be maintained at the boiling temperature till it reaches a paste consistency and then temperature is lowered to 88oC till the pat formation stage. The dehydration should be stopped when the pan contents starts leaving the pan surface and shows a tendency to stick together. Continued heating at higher temperature at advanced stage of khoa making results into undesirable flavour (cooked) and texture (hands dry). The colour of such product is also brown. Slow heating is not only more time consuming but also produces sandy texture and brown colour.

5.4.2 Homogenization of milk
Homogenization of cow/ buffalo milk produces a softer body in khoa, as against an homogenized milk. The khoa from homogenized milk also shows lower fat leakage, less browning, and a reduced patting tendency as compared to that obtained from unhomogenized milk.

5.5 Physico-Chemical Changes in milk during Khoa making
The changes in physico-chemical characteristics of milk during khoa making take place due to three actions. 1) concentration 2) heating and 3) Stirring and scraping

1) Change of State
The removal of moisture from milk results into concentration of milk solids. This eventually changes the state of milk from liquid to solid/ semisolid. All the constituents including lactic acidity increase in proportion to the degree of concentration. pH decreases.

2) Development of Cooled flavour
Heating of milk causes changes in proteins resulting in the production of sulphydryl compounds by denaturation of whey protein particularly β-Lactoglobulin.

3) Coagulation of casein
Due to the combined action of heat and concentration coagulation of casein tends to increase logarithmically with milk solids concentration and forms a complex with denatured whey protein.

Convention of soluble calcium and phosphate to colloidal form and interaction between protein compounds.

Super-saturated solution of lactose: From a dilute solution in milk, lactose is present in khoa as a super-saturated solution. Most of the lactose is present as α-hydrate in khoa.

Free fat formation: (Free fat in khoa is 60% of the total fat in khoa, Cow khoa = 50% of the total fat). By vigorous stirring and scraping, the fat globule membrane ruptures, thereby releasing considerable amount of free fat in khoa.

The water dispenses as fine droplets in mass of the khoa.
Change in colour intensity: The colour of *khoa* becomes intense with brownish tinge due to formation of melanoidins pigment. The browning reaction is maillard type reaction due to interaction between aldose group of lactose and free amino group of casein.

Increase in iron content: From 2 to 4 ppm iron content in milk, the iron content of *khoa* increases more than 100 ppm due to the incorporation of additional quantities of iron from the *karahi* and the *khunti* by vigorous scraping.
Lesson 6
PACKAGING AND SHELF LIFE OF KHOA; DEFECTS IN KHOA AND USES OF KHOA

6.1 Introduction
In general, khoa can keep well for 2-3 days at room temperature and for a week under refrigerated storage conditions. The shelf life of khoa is mainly dependent on moisture content of khoa, temperature of storage, bacteriological quality of raw milk, hygienic conditions maintained during production, duration of storage, type of package and method of packaging.

6.2 Keeping Quality of Khoa
The limited shelflife of indigenous milk products is one of the main limiting factors in marketing. During storage, these products undergo many types of sensory, rheological, chemical and microbiological deterioration making them unfit for human consumption. Most of the traditional dairy products except ghee have shelflife varying from less than 24 hours to about a week at ambient temperature. Addition of sugar, boiling in sugar syrup or frying is some of the methods which are traditionally adopted to enhance the storage life of these products.

The keeping quality of khoa at room temperature is about 5 days and 10 weeks at the refrigeration temperature. Storage of khoa at low temperature (5-10°C) though enhances the keeping quality, it adversely affects the body and texture and its portability for sweet making. Hence all care should be taken during manufacture and subsequent handling.

The following factors control the keeping quality of khoa (water activity of khoa is 0.960):

1) Quality of raw material - Use of poor quality milk particularly sour or neutralized lowers the keeping quality of the final product.
2) Quality of khoa - Khoa having high moisture (ideal is 30-50% moisture) content has very poor shelf life. The high amount of fat (30-40%) particularly free fat, in presence of copper and iron is very much favorable for oxidized flavour. Therefore, khoa should not be contaminated with these pre-oxidant catalysts (The ideal moisture)

Manufacturing Conditions
Sanitary conditions should be adopted at all stages of manufacture of khoa and its subsequent handling. Minimum is the contamination with micro-organisms, better will be the keeping quality of khoa.

Temperature of storage
Higher the temperature of storage, lower is the shelf life and vice versa.

<table>
<thead>
<tr>
<th>Temp. of storage</th>
<th>Shelf life on days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unpacked</td>
</tr>
<tr>
<td>5°C</td>
<td>≤ 10</td>
</tr>
<tr>
<td>30°C</td>
<td>≈ 5</td>
</tr>
<tr>
<td>37°C</td>
<td>≈ 3</td>
</tr>
</tbody>
</table>

Temp. of storage Shelf life on days
Unpacked Packed in laminates
5°C ≤ 10 > 30
30°C ≈ 5 6-7
37°C ≈ 3 ≤ 5
At room temperature (24-30°C) a rancid flavour is developed on khoa while at low temperature (5-10°C) a stale and sour flavour is observed and there is mould growth on the surface.

**Type of Package**
Shelf life of khoa is in increasing order, open tray < parchment paper < LDPE < Food grade HDPE < Laminates < Tins

**Methods of Packaging**
The method of packaging is very important in relation to keeping quality of khoa. Packaging of khoa under aseptic environment and selection of an appropriate packaging material improves the keeping quality of khoa.

6.3 Improving Shelf Life of Khoa

6.3.1 Packaging
Under existing trade practice, producers and traders do not employ any packaging for khoa. By employing proper packaging, the shelf life of khoa can be enhanced. Hot packaging of khoa in pre-sterilized cans can improve the shelf life up to 14 days at room temperature and 75 days under refrigerated temperatures. Three times increase in shelf life was claimed by packing khoa in rigid polypropylene containers with lid. Vacuum packaging and packing in Cryovac Shrink wrap pouches will prevent growth of aerobic microorganisms in khoa. However, these two packaging methods do not offer protection against bacteria growing inside khoa.

6.3.2 Thermal treatment
Hot filling of khoa in rigid containers at 85°C is useful in extending the shelf life of khoa. Packaging of khoa in aluminium cans and steaming them for 15 to 20 min will prevent the spoilage for few weeks. Deep freezing of khoa and storing at -10 to -20°C will extend the shelf life for considerably long periods. However, at this temperature of storage, the lactose which is in super saturated state in khoa gets crystallized and gives rise to sandiness defect.

6.3.3 U.V. irradiation
Irradiation of khoa with U.V. rays will preserve the khoa up to 25 days. However, oxidation changes are caused by U.V. irradiation affecting the flavour of khoa.

6.3.4 Chemical preservation
Under Food Safety and Standards regulations, no preservative should be added to khoa. However, some attempts were made to improve the shelf life of khoa by adding mould inhibitors, nisin and antioxidants. Antifungal agents like sorbic acid, propionic acid and their salts can be used to preserve khoa. Addition of 0.2% sorbic acid by weight of khoa during the last stage of its manufacture will enhance the shelf life up to 20 days at 30°C and 125 days in cold storage. The mould inhibitors can be sprayed on to the surface of the product or alternatively the packaging material can be treated with the chemical agent. Addition of Nisin (Nisaplin) will improve the shelf life of khoa by 10-11 days at 30°C.

6.4 Chemical and Microbial Changes in Khoa During Storage

6.4.1 Chemical Changes
1. Moisture: Loss of moisture takes place resulting into dry and hard surface of khoa. The extent of evaporation however depends on the temperature of storage and packaging material. The higher the storage temperature the higher is the rate of evaporation. More the water vapour transmission rate (WVTR) of package faster the loss of water from khoa. Minimum loss of moisture takes place in case of tins and maximum loss in parchment paper.
2. Acidity: Lactic acidity increases with the storage period. Higher percentage increase take place at higher temperature and vice-versa. The pH normally decreases during storage corresponding to the increase in acidity.
3. Deterioration in fat: The peroxide value increases due to oxidative spoilage during storage of khoa, particularly at ambient temperature. The hydrolytic rancidity in khoa take place thereby increasing the free fatty acids measured as % oleic acid.
4. **Breakdown in milk protein**: There is break down of milk protein in khoa as recorded by the increase in tyrosine value.

5. **Changes in organoleptic quality**: The changes in organoleptic quality of khoa during storage include development of off flavour (stale, sour, oxidized, etc) hardening of body and texture and increase in intensity of colour.

6. **Microbial changes**: The hygienic quality of a food product is judged by microbiological analysis for indicator organisms(s) which shows the safety and keeping quality by revealing the sanitation at the place of manufacture and also during processing, marketing, transportation and storage. Most of the Indian milk products are almost sterile when fresh, it is the post manufacture contamination and unhygienic handling that makes the microbiological quality far from satisfactory on account of moisture content the storage at high ambient temperatures. Aerobic spore formers, staphylococci and micrococci are the dominant groups and frequent occurrence of coliform and *Staphylococcus aureus*, *salmonella* and *Bacillus cereus* etc. have been reported in indigenous milk products.

Milk is subjected to boiling temperature for a considerably long time (15-20 min), during manufacture of khoa. Therefore except spores all other micro-organisms are destroyed during khoa making. Khoa manufactured by continuous methods in practically sterile when comes out of the machine. On the contrary khoa made by traditional methods contains comparatively high microbial load. Despite high heat treatment, heavy load of all types of microflora has been observed in market khoa samples which are the result of adoption of unhygienic condition and post production contamination. The aerobic spore formers and the moulds are mainly responsible for the microbial spoilage of khoa.

### 6.5 Defects in Khoa

Defects in khoa arise from inferior quality milk, unhygienic conditions during manufacturing and duration of storage. Some of the common defects observed in khoa are listed below.

**Table 6.1 Defects in khoa, causes and prevention**

<table>
<thead>
<tr>
<th>Defects</th>
<th>Causes</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Flavour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoky</td>
<td>Smoky fire used for boiling and dehydration of milk</td>
<td>Using non-smoky fire for boiling and dehydration of milk</td>
</tr>
<tr>
<td>Sour/ Acid</td>
<td>Excessively high acidity in milk used</td>
<td>Using fresh sweet milk</td>
</tr>
<tr>
<td>Rancid</td>
<td>Fat hydrolysis due to lipase action in khoa during storage (at room temperature and above)</td>
<td>Storage of khoa at low temperature (5-10°C)</td>
</tr>
<tr>
<td>Stale</td>
<td>Excessively long period of storage of khoa at low temperature (5-10°C)</td>
<td>Early disposal/ marketing of khoa</td>
</tr>
</tbody>
</table>
### b) Body and texture

<table>
<thead>
<tr>
<th>Hard body</th>
<th>Excessively low fat content of milk used</th>
<th>Using milk of optimum fat content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excessively low moisture content of khoa, due to faulty production technique</td>
<td>Optimum moisture content of khoa by adopting correct production technique</td>
</tr>
<tr>
<td>Coarse texture</td>
<td>Excessively high acidity in milk used</td>
<td>Using fresh sweet milk</td>
</tr>
<tr>
<td></td>
<td>Excessively low fat content of milk used</td>
<td>Optimum temperature of dehydration, especially in the last stages</td>
</tr>
<tr>
<td></td>
<td>Excessively high temperature of dehydration, especially in the last stages</td>
<td>Optimum speed when stirring milk/pan-content</td>
</tr>
<tr>
<td>Gritty texture</td>
<td>Presence of sand-like particles due to incorrect straining of milk</td>
<td>i) Correct straining of milk</td>
</tr>
<tr>
<td></td>
<td>Presence of large crystals of lactose due to incorrect method of manufacture</td>
<td>ii) Correct method of manufacture</td>
</tr>
</tbody>
</table>

### c) Colour and appearance of dry surface

<table>
<thead>
<tr>
<th>Visible Dent/foreign matter</th>
<th>Excessively low fat content of milk used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i) Incorrect or no straining of milk used</td>
</tr>
<tr>
<td></td>
<td>ii) Heating-pan and/or stirrer not cleaned</td>
</tr>
<tr>
<td></td>
<td>iii) Dirty/windy surroundings during manufacture and/or handling of khoa</td>
</tr>
<tr>
<td>Browning/Burnt particles</td>
<td>i) Excessively high heating-temperature, especially in the last</td>
</tr>
<tr>
<td></td>
<td>ii) Optimum heating temperature, especially in the last</td>
</tr>
</tbody>
</table>

### 6.6 Uses of Khoa

- **Khoa** is mainly used in the manufacture of a variety of khoa based sweets like **gulabjamun, peda, burfi, kalakand, milk cake** etc.
- **Khoa** is used in the preparation of carrot **halwa, palangtod, laddoo** etc.
- **Khoa** is used as a topping for **payasam, kaddu ka kheer**, other sweets etc.
- **Khoa** is used for direct consumption after mixing with sugar.

*******😊*******
Lesson 7

**PEDA – PRODUCT DESCRIPTION, METHOD OF PREPARATION, QUALITY, PACKAGING AND SHELF LIFE**

7.1 Introduction
A variety of sweets are prepared from khoa. Three varieties of khoa are used in the preparation of different varieties of sweets. Khoa admixed with chhana also forms base for some milk sweets.

7.2 PEDA

Peda is a sweet prepared from pindi variety of khoa by the addition of sugar. Since peda contains sugar and lower moisture content it has a better keeping quality than khoa. Peda have religious importance as they are offered as “Prasad” during worship of God in the temples. Peda is also offered to guests at the time of ceremonial celebration like marriages etc. Some region specific varieties are popular in different regions of the country. Doodh peda is the common variety and is popular all over India. Peda is characterized as a circular slightly flattened ball with low moisture content and white to creamy white in colour and smooth texture.

![Flow diagram of Preparation of peda from khoa](image)
7.2.1 Dharwad peda
It gets its name from Dharwad region of Karnataka State. In the traditional process, khoa is fried in ghee and mixed with sugar. It is a brown coloured product with sugar crystals seen on the surface. This has longer shelf life than doodh peda owing to low moisture content and high sugar content coupled with ghee frying.

7.2.2 Thirattupal
It is popular in Tamil Nadu and Kerala states and characterized by coarse granular texture. Slightly sour milk or small quantity of curd is added to hot milk during preparation of this sweet to get granular texture.

7.2.3 Lal peda
It is highly browned peda with intense cooked flavour and lot of free fat is prepared in some parts of Eastern Uttar Pradesh, Varanasi, etc with cardamom flavour.

7.3 Method of Preparation of Doodh Peda
7.3.1 Traditional method
About 5 litres of buffalo milk is taken in an open pan and heated on a brisk non smoky, fire. When the milk reaches a rabri stage, about 400 - 450 gm sugar is added and stirring and scraping continued until a pasty consistency is obtained. During the last stages of heating, the paste is worked up into a smooth mass. The heating is then stopped; the paste is spread on the walls of the pan for cooling. Then the product is shaped in to either flattened circular balls or rectangular shapes.

7.3.2 Preparation of peda from khoa
Pindi khoa is broken into bits and heated to 90˚C. Powdered sugar @ 30% on the basis of khoa is added and heating is continued with rigorous working to obtain a smooth pasty consistency. Then the product is cooled and shaped on moulds.

7.4 Quality of Peda
Chemical quality of peda depends on:

- Type and quality of milk,
- Quality of khoa if used,
- Amount of sugar added,
- Method of production
- Optional ingredients and flavors added
- Storage conditions

<table>
<thead>
<tr>
<th>Chemical Constituents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>13.5</td>
</tr>
<tr>
<td>Fat</td>
<td>20.0</td>
</tr>
<tr>
<td>Protein</td>
<td>19.5</td>
</tr>
<tr>
<td>Lactose</td>
<td>16.3</td>
</tr>
<tr>
<td>Sucrose</td>
<td>31.8</td>
</tr>
</tbody>
</table>

7.5 Packaging and Shelf Life of Peda
7.5.1 Packaging of peda
Peda is generally packed in paper board containers lined with parchment paper or grease proof paper. However, plastic trays, tubs can be used to pack peda to enhance its marketability. Peda packed either in polythene bags or parchment paper lined paper board boxes can keep well for 7 days at room temperature and 30 days at refrigeration temperature. Use of laminates with oxygen scavenger property is also advocated.
7.5.2 Shelf life of peda
Generally peda can keep well for 5-7 days at room temperature. Peda packed in multilayer transparent laminate pouches under modified atmospheric packing of Nitrogen and CO2 had a shelf life of 15 days at room temperature and 30 days at 20°C. Peda samples packed in pouches with oxygen scavenger exhibited a shelf life of 2 months at 37°C and 6 months at 20°C.
Lesson 8

BURFI – VARIETIES, STANDARDS, METHOD OF PREPARATION, CHEMICAL COMPOSITION, QUALITY, PACKAGING AND SHELF LIFE

8.1 Introduction

Burfi is one of the most popular khoa based indigenous sweets. It is white to light cream in colour with firm body and smooth texture with very fine grains. Sugar is added in different proportions and other ingredients incorporated according to the demand of consumers. Several varieties of burfi are sold in the market viz. plain, nut (kaju, pista), chocolate, coconut and rava burfi. A lot of variation is observed in chemical composition, sensory and rheological characteristics in market samples of burfi. The cause of large variations in market samples is due to non existence of legal standards.

8.2 Varieties of Burfi

Several varieties of burfi are sold in the market. Depending on the additives present, some of the common varieties of burfi are:

- Mawa burfi
- Layered burfi
- Fruit burfi
- Nut burfi
- Cashew burfi
- Chocolate burfi
- Coconut burfi
- Rava burfi

8.3 Methods of Production

Buffalo milk is preferred for making burfi. Milk used for burfi should not have objectionable flavours and titratable acidity should not be more than 0.16 percent. Milk is filtered before use to remove visible objectionable foreign matter. Standardized buffalo milk with 6% fat and 9% SNF in quantities of 4-5 lit per batch is taken in a double jacketed stainless steel kettle and heated. Milk is boiled continuously with constant stirring and scraping so as to avoid burning of solids on the surface of the kettle. When a semisolid consistency is attained, heating is discontinued. Powdered sugar @ 30% on the basis of khoa is added and blended thoroughly into khoa with the help of a flattened wooden ladle. When a homogeneous mass with desirable flow characteristics is achieved, the blend is transferred to greased trays. The product is allowed to set for minimum of 4 hours. Then burfi is cut into desirable shapes and sizes with a knife and packed burfi is stored at room temperature.
Flow diagram for the manufacture of *burfi* from standardized buffalo milk is given below:

**Fig. 8.2 Flow diagram for the manufacture of Burfi from standardized buffalo milk**
8.3.1 Preparation of burfi from pre-made khoa
Burfi can also be prepared from pre made khoa obtained from market. Hot sugar syrup is prepared from 300 gm sugar by adding minimum quantity of water. Hot sugar syrup is added to 1 kg khoa and heated to 80˚C. The mixture is kneaded properly and when desirable flow characteristics are attained, it is poured in trays and allowed to set at room temperature.

8.3.2 Manufacture of burfi from concentrated milk
Acceptable quality burfi can be prepared from concentrated milk. Concentrated milk with 35% total solids is taken and heated in a kettle. When a semisolid consistency is reached, ground sugar @ 30 percent on khoa weight basis is added and kneaded. When desirable flow characteristics are seen in the product, the mix is emptied into trays and set-aside.

8.3.3 Preparation of burfi from cream and skim milk powder
Cream with 30 per cent fat and skimmed milk powder are mixed in 1:2 ratio. The mixture is heated to 92˚C and heating is continued till 75 per cent total solids are attained in the product. The heating is then stopped; ground sugar is added at 50˚C and kneaded. Then mixture is poured in to trays for setting.

8.3.4 Mechanized production of burfi
A mechanized process for commercial production of burfi was successfully developed by the NDDB. All the ingredients, like khoa, sugar, additives, such as cardamom, etc, are first heat processed to blend uniformly in a planetary mixer. The processed ingredients are then fed to a Rheon-shaping and forming machine. A die is placed at the end of the encrusting. Machine gives shape to the burfi emerging out from the machine in a continuous uninterrupted flow. Burfi is then packed.

8.4 Standards for Burfi
No legal standards are presently prescribed under Food Safety and Standards regulations. However, Bureau of Indian Standards has recommended the quality standards.

8.4.1 BIS Specifications of burfi
The Bureau of Indian Standards has recommended the following quality standards.

Table 8.1 BIS specifications for burfi

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mawa Burfi</th>
<th>Other Burfi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture % by wt max</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Milk fat % by wt min.</td>
<td>12.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Lactose % by wt min</td>
<td>15.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Sucrose % by wt max</td>
<td>48.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Acidity % as Lactic Acid max</td>
<td>0.35</td>
<td>0.45</td>
</tr>
<tr>
<td>Standard plate count /gm max</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Yeast &amp; moulds count/ gm max</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

8.4.2 Chemical composition
The chemical composition of burfi depends upon the quality and composition of milk, amount of sugar and other ingredients and extent of desiccation. An average chemical composition of a good quality burfi prepared from buffalo milk (6% fat & 90% SNF) is given in Table 8.2
Table 8.2 Average chemical composition of market samples of *burfi*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>15</td>
</tr>
<tr>
<td>Fat</td>
<td>20.50</td>
</tr>
<tr>
<td>Protein</td>
<td>16.12</td>
</tr>
<tr>
<td>Lactose</td>
<td>15.83</td>
</tr>
<tr>
<td>Sucrose</td>
<td>30.10</td>
</tr>
<tr>
<td>Ash</td>
<td>2.45</td>
</tr>
</tbody>
</table>

Buffalo milk is preferred for making *burfi*. The milk should not have any objectionable odour/smell and taste and not more than 0.16 to 0.17% lactic acidity. COB test should be negative. Milk is standardized to 6% fat and 9.0% SNF and *khoa* is made. Sugar @ 25-30% by wt. of *khoa* is added (preferably ground sugar). Kneading and whipping of the mixture of *khoa* and sugar is done with the help of a wooden ladle which has a long handle with one end flattened. The temperature is maintained at 50˚C as soon as a homogenous mass with smooth texture is obtained, the contents are transferred to a tray, in which the inner surface has been given a coating of ghee. Additives are incorporated at this stage. When the mass is properly set, pieces of rectangular shape and desirable size are cut out and packaged in appropriate packaging material. Presently *burfi* is packed in paper board boxes lined with parchment paper in sizes of 500 gm, 1 kg and 2 kg.

8.5 Shelf-life of *Burfi*

Low moisture content and presence of sugar keeps *burfi* well for fairly long periods. The shelf life of *burfi* packed in parchment paper is 15 days at 30˚C and 50 days at 5˚C.

8.5.1 Extension of shelf life of *burfi*

8.5.1.1 Low moisture content in *Burfi*

*Burfi*-samples with very low moisture could be stored for 6 months however such lower moisture content renders *burfi* hard, dry, chewy and unacceptable for the consumer.

8.5.1.2 Addition of antioxidants

*Burfi* samples treated with propyl gallate and dodecyl gallate and stored at 25˚C kept well for 12 months.

8.5.1.3 Packaging in tins

*Burfi* packed in tins and stored at 30˚C ±10˚C was good for 150 days.

8.5.1.4 Hot filling

Filling *burfi* into tins while hot was suggested to prevent the growth of moulds and off-flavour development during storage for a period of one year.

8.5.1.5 Use of antifungal agents

Incorporation of 0.15% sorbic acid in *burfi* and packaging in polyethylene pouches enhanced the shelf life of *burfi* up to 90 days.
Lesson 9

KALAKAND – PRODUCT DESCRIPTION, METHOD OF PREPARATION, CHEMICAL COMPOSITION, PACKAGING AND SHELF LIFE

9.1 Introduction

Kalakand is a milk sweet basically prepared from Danedar variety of khoa. Kalakand is characterized by large sized hard grains with less cohesive body. The chemical composition of Kalakand is more or less similar to burfi, but there are large differences in the sensory and rheological properties of the two sweets. Contrary to burfi, kalakand has more distinct cooked flavour and brown colour. The body of kalakand is greasier with grainy texture. The grains are hard and of large size. Good quality kalakand is normally prepared in one step from buffalo milk. However, it can also be prepared from khoa. The firmly set product is cut to required shape and size. When making kalakand from khoa, danedar variety is used.

9.2 Method of Production

9.2.1 Preparation of kalakand from milk

Buffalo milk is preferred for kalakand manufacture. Slightly sour milk (upto 0.18% lactic acid) can be used for its preparation. Buffalo milk standardized to 6% fat and 9% SNF is taken in a pan and boiled. At the appearance of first boiling, 0.05% citric acid (on weight of milk) dissolved in small quantity of water is added to milk. There is no need to add citric acid in case of slightly acidic milk. The milk is boiled with continuous stirring and scraping. At pat formation stage, sugar @ 30% on expected yield of khoa or alternatively 7.5% on the basis of milk is added and stirring is continued. When desirable textural and body characteristics are achieved, mixture is removed from fire and poured in a tray, smeared with a thin layer of ghee for setting. The kalakand is cut into desirable shapes or alternatively served as such without any definite shape.
9.2.2 Preparation of kalakand from khoa

Danedar khoa is taken in a pan and heated. To this sugar @ 30% is added and heating is continued with stirring. When desirable flow characteristics are observed, kalakand is poured into a tray and set for minimum 4 hr.

9.3 Chemical Composition

The gross composition of kalakand is nearer to the composition of burfi. Chemical quality of market kalakand samples is given in the Table 9.1 and laboratory made kalakand in Table 9.2. Market samples carry higher amount of moisture and lower percentage of fat than lab made samples. The chemical composition of kalakand chiefly depends on quality of milk, method of production and amount of sugar added.
Table 9.1 Chemical quality of kalakand collected from various towns of India

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Range %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Solids</td>
<td>63.59 – 84.75</td>
</tr>
<tr>
<td>Fat</td>
<td>4.75 – 26.46</td>
</tr>
<tr>
<td>Protein</td>
<td>9.40 – 17.91</td>
</tr>
<tr>
<td>Sugar</td>
<td>15.38 – 42.41</td>
</tr>
<tr>
<td>Lactose</td>
<td>11.96 – 21.90</td>
</tr>
<tr>
<td>Ash</td>
<td>1.78 – 3.48</td>
</tr>
<tr>
<td>Acidity</td>
<td>0.26 – 0.70</td>
</tr>
</tbody>
</table>

Samples taken from all over India. Arora et al., (1991)

Table 9.2 Composition of laboratory made kalakand

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Lab made Kalakand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Buffalo</td>
</tr>
<tr>
<td>Moisture</td>
<td>16.16</td>
</tr>
<tr>
<td>Total solids</td>
<td>83.84</td>
</tr>
<tr>
<td>Fat</td>
<td>23.65</td>
</tr>
<tr>
<td>Titratable acidity</td>
<td>0.31</td>
</tr>
</tbody>
</table>

9.4 Factors Affecting Sensory Quality
The sensory attributes of kalakand such as colour, body and texture and the overall acceptability of the finished product are dependent on fat % of milk, quantity of sugar, strength and type of coagulant, and moisture content.

9.4.1 Fat
Cohesiveness of kalakand is optimum in the samples made with 6 percent fat milk. If the fat content of milk is lower than 6 percent, it yields less acceptable product.

9.4.2 Sugar
Good quality kalakand can be obtained by using sugar at 7.5 percent level. Higher level yields inferior colour. A sugar content of 11 percent on the basis of milk results in cooked flavour, and excessive sweetness and browning in the final product.

9.4.3 Strength and type of coagulant
Citric acid at 0.02-0.05 percent levels is commonly used to induce good granule formation during kalakand preparation. Use of 0.02 percent citric acid results in kalakand possessing optimum chewiness, gumminess and hardness values.

9.5 Yield of Kalakand
275 gm of kalakand can be obtained from 1 kg buffalo milk. Cow milk gives comparatively lower yield being 225 gm for every kg of milk.
9.6 Packaging and Shelf Life of Kalakand

The shelf life of kalakand is 3-5 days at room temperature (30°C) and 15-20 days at refrigeration temperature (8-10°C). Due to its high water activity, kalakand is highly susceptible to microbial and enzymic spoilage. Attempts have been made to prolong the shelf life of kalakand up to 21 days by wrapping it in parchment paper and storing under refrigeration temperature (8-9°C). Kalakand packaged under vacuum in metalized polyester and saran-coated cellophane/ LDPE pouches and stored in cartons remains acceptable for 50 days and 21 days at 6-10°C and 30°C, respectively. Kalakand samples with 0.2 percent potassium sorbate and packaged in polyethylene bags pre-exposed to UV irradiation for 20 minutes and stored at 30 ± 1°C and 37 ± 1°C remained acceptable up to 24 and 15 days, respectively.

******** 😊 ********
Lesson 10
MILK CAKE – PRODUCT DESCRIPTION, METHOD OF PREPARATION, QUALITY, PACKAGING AND SHELF LIFE

10.1 Introduction
Milk cake is a khoa based sweet prepared from either buffalo milk or from danedar variety of Khoa. Milk cake differs from kalakand for its higher content of sugar, lower moisture content and slightly more sticky and chewy grains. Milk cake has two distinct layers i.e. central dark brown colored caramelized centre covered by light colored product on the entire surface. Whereas, kalakand is characterized by uniform whitish to light brown colour throughout the mass.

10.2 Method of Production
Whole buffalo milk is boiled in an open pan. When milk comes to first boil, 0.05% citric acid on milk basis is added as 1% solution. After addition of citric acid solution, small tiny granules tend to appear in milk. Heating is continued further with rigorous stirring. When the mass shows signs of leaving the surface of pan, sugar @ 50 percent of expected khoa yield 12.5% on the basis of milk is added and the mix is heated with rigorous stirring. Controlled heating is required at this stage to obtain better quality product. When the product shows signs of dry appearance, the mix is poured in deep metal moulds while hot. The milk cake is allowed to cool slowly at room temperature so that the central portion of the pat turns brown and caramelized flavour develops due to residual heat. After cooling, the product is cut into desirable sizes. At times, the vessel containing the hot mass is placed in a container with water so that the surface of milk cake cools fast giving white appearance outside and brown coloration in the central core.

Fig. 10.1 Flow Diagram of preparation of Milk cake
10.3 Quality of Milk Cake

<table>
<thead>
<tr>
<th>Product</th>
<th>Total Solids %</th>
<th>Fat %</th>
<th>Protein %</th>
<th>Lactose %</th>
<th>Sucrose %</th>
<th>Ash %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Cake</td>
<td>84.17</td>
<td>21.32</td>
<td>11.38</td>
<td>7.67</td>
<td>40.46</td>
<td>2.29</td>
</tr>
</tbody>
</table>

10.4 Packaging of Milk Cake
The pieces of milk cake are generally packed in vegetable parchment lined paper board boxes. Individual pieces are packed in LDPE pouches.

10.4 Shelf Life
Since milk cake contains higher amount of sugar and lower moisture content, it has longer shelf life than kalakand. Milk cake will have 15-20 days shelf life at room temperature.

******** ☺ ********
Lesson 11

**GULABJAMUN – PRODUCT DESCRIPTION, METHOD OF PREPARATION, QUALITY, PACKAGING AND SHELF LIFE**

11.1 Introduction

*Gulabjamun* is a *khoa* based sweet popular all over India. *Dhap* variety of *khoa* having 40-45% moisture is preferred for *Gulabjamun* preparation. Manufacture of *Gulabjamun* is largely in the hands of halwais who adopt small scale batch method. There are large variations in the sensory quality of *Gulabjamun*. The most liked product should have brown colour, smooth and spherical shape, soft and slightly spongy body, free from both lumps and hard central core, uniform granular texture, with cooked flavour and free from doughy feel and the sweet should be fully succulent with sugar syrup with optimum sweetness.

11.2 BIS Specifications of *Gulabjamun*

*Gulabjamun* shall be prepared from khoa, skim milk powder, milk powder, ghee, cream, butter or other milk solids. It may contain maida (wheat flour), citric acid and baking powder. It shall be free from dirt and other foreign matter as well as insects and mould growth. It should be, as far as possible, manufactured and packed under hygienic conditions. The proportion of free syrup in an *agulabjamun* pack shall not exceed 60% of the declared net mass.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Requirements for <em>Gulabjamun</em> (IS: 11602: 1986, Reaffirmed 1997)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture, % by mass, Max</td>
<td>30.0</td>
</tr>
<tr>
<td>Fat, % by mass, Min</td>
<td>8.0</td>
</tr>
<tr>
<td>Protein, % by mass, Min</td>
<td>8.0</td>
</tr>
<tr>
<td>Concentration of sugar in syrup, % by mass, Min</td>
<td>40.0</td>
</tr>
<tr>
<td>Bacterial count, per g, Max</td>
<td>3000</td>
</tr>
<tr>
<td>Coliform count, per g, Max</td>
<td>50</td>
</tr>
<tr>
<td>Yeast and mould count, per g, Max</td>
<td>50</td>
</tr>
</tbody>
</table>

11.2.1 Requirements for sugar syrup

The sugar syrup shall be clear and light to golden yellow in colour, and shall conform to the requirements given in the table as follows. The proportion of free syrup in a gula...
11.3 Chemical Composition
The chemical composition of *Gulabjamun* vary widely depending upon the composition and quality of khoa, proportion of ingredients used, sugar syrup concentration, etc.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>25-35</td>
</tr>
<tr>
<td>Fat</td>
<td>8.5 to 10.5</td>
</tr>
<tr>
<td>Proteins</td>
<td>6.0 to 7.6</td>
</tr>
<tr>
<td>Ash</td>
<td>0.9 to 7.6</td>
</tr>
<tr>
<td>Total carbohydrates (Including lactose)</td>
<td>43.0 to 48.0</td>
</tr>
</tbody>
</table>

11.4 Method of Preparation
*Dhap* variety of *khoa, maida* and baking powder (750 g *khoa*, 250 g *maida* and 5 g baking powder) are blended to form homogenous and smooth dough. Small amount of water can be added in case of hard dough and if it does not roll into smooth balls. The mix should be prepared fresh every time. The balls are then deep fat fried at 140° C to golden brown colour and transferred into 60% sugar syrup maintained at 60 °C. It takes about 2 hours for the balls to completely absorb sugar syrup.

11.4.1 Mechanized production of *Gulabjamuns*
A mechanized semi-continuous system, developed by NDDB, for the manufacture of *Gulabjamun* from *khoa* employs meat ball forming machine and potato chip fryers (Fig. 11.2).
11.3.2 Preparation of *Gulabjamun* from instant *jamun* mix
The existing method of *Gulabjamun* preparation is suitable for cottage scale and cannot be adopted for large scale production. During summer months and festive seasons, *khoa* in required quantities may not be available to prepare *Gulabjamuns*. To meet *khoa* shortage and to produce *Gulabjamun* on a commercial scale, instant *Gulabjamun* mix was developed by Central Food Technology Research Institute, Mysore long back using spray dried skimmed milk powder, maida, vanaspati, citric acid, tartaric acid and baking soda.

A complete *Gulabjamun* mix was also formulated in National Dairy Research Institute, Karnal based on roller dried skimmed milk.

### Table 11.4 Formulation of *Gulabjamun* mix from roller dried skimmed milk

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller dried skimmed milk</td>
<td>43.4</td>
</tr>
<tr>
<td>Maida</td>
<td>25.0</td>
</tr>
<tr>
<td>Suij</td>
<td>15.0</td>
</tr>
<tr>
<td>Vanaspati/Butter oil/ghee</td>
<td>15.0</td>
</tr>
<tr>
<td>Baking Powder</td>
<td>1.5</td>
</tr>
<tr>
<td>Cardamom Powder</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Traders prefer to use spray dried skimmed milk powder as it is readily available in larger quantities. The formula from spray dried skimmed milk powder will carry higher amounts of maida and lower quantities of skimmed milk powder. This formula contains no suji and is a trade secret of each company.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture, percent by mass, Maximum</td>
<td>8</td>
</tr>
<tr>
<td>Acid insoluble ash (on dry basis), percent by mass, Maximum</td>
<td>0.1</td>
</tr>
<tr>
<td>Total protein (on dry basis) (N x 6.25), percent by mass, Minimum</td>
<td>15</td>
</tr>
<tr>
<td>Fat (on dry basis) percent by mass, Minimum</td>
<td>12</td>
</tr>
<tr>
<td>Carbohydrates, percent by mass, Maximum</td>
<td>60</td>
</tr>
<tr>
<td>Leavening index, Minimum</td>
<td>1.25</td>
</tr>
<tr>
<td>Coliform count per gram</td>
<td>Nil</td>
</tr>
<tr>
<td>Staphylococcus count, per gram</td>
<td>Nil</td>
</tr>
</tbody>
</table>

11.4 Yield
The yield of gulabjamun is expressed in terms of drained weight. In general, 1 litre buffalo milk is expected to give 1 kg gulabjamun.

11.5 Shelf Life
The shelf life of Gulabjamun at ambient temperature, in sugar syrup is 5–7 days which can be extended to 3 weeks by hot filling in polystyrene tubs and adding 0.1% potassium sorbate as a preservative. Product is filled hot in previously sterilised metal cans after running through a steam chest for 7-8 min and sealed. This process is expected to give a shelf life of 6 months at room temperature.

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Lesson 12

**RABRI – PRODUCT DESCRIPTION, METHODS OF PREPARATION, YIELD, PACKAGING AND SHELF LIFE**

12.1 Introduction

*Rabri* is a sweetened concentrated whole milk product with thickened *malai* layer obtained by evaporation and concentration of milk. Buffalo milk is preferred for preparation of *rabri*.

12.2 Method of Manufacture

12.2.1 Traditional method

Whole buffalo milk is taken in a karahi and slowly heated at simmering temperature. The milk is not allowed to boil so that clotted cream may form on its surface. Slow evaporation of moisture takes place and the layer of resulting clotted cream is continuously removed with a fork and placed on the sides of karahi. When the volume of milk is considerably reduced, sugar @ 5-6 percent of milk is added and stirred. The clotted cream collected on the sides of the pan is gently added back to the sweetened concentrated milk. The clotted cream is broken into small bits by wooden ladle before addition to milk. Whole mass then appears to be concentrated sweetened milk with clotted cream. Higher the amount of clotted cream better will be the quality of *rabri*.

![Fig. 12.1 Flow diagram for preparation of Rabri](image)

Fig. 12.1 Flow diagram for preparation of *Rabri*
12.2.2 Improved batch method
A small scale process was developed for the manufacture of *rabri*. The process includes heating of whole buffalo milk with 6% fat in a steam jacketed stainless steel kettle to 90-95°C and holding at this temperature for some time without any agitation. The *malai* (pellicle) formed on the surface of milk may be removed in a separate container after every 10 min. After collecting about 500 g *malai*, the temperature of milk is raised to boiling. Pre-determined quantity of sugar (@ 6% on milk basis) is added to the concentrated milk and mixed well. Subsequently, *malai* collected in a separate vessel is added back and mixed. The product is then cooled to < 10°C and served.

12.2.3 Large scale manufacture of *rabri*
Two types of concentrated milks were used as base materials for large scale production of *rabri*. In one process, buffalo milk with 2% fat was concentrated to 35% TS in a scraped surface heat exchanger. In another method buffalo skim milk was concentrated in a vacuum pan to contain 35% total solids. The concentrated milks were heated up to 90°C followed by addition of sugar @12% of the product. The mixture was then cooled to 70°C and calculated amount of *malai* is added to it. The *malai* could be prepared from buffalo milk by simmering it in an open kettle. However *rabri* obtained by these two methods was liked ‘slightly’ by judges indicating necessity for further improvement in the process.

12.3 Chemical Composition
Chemical composition of *rabri* depends on initial quality of milk, type of milk, degree of concentration, quantity of sugar added and method of manufacture.

**Table 12.1 Chemical composition of *rabri***

<table>
<thead>
<tr>
<th>Constituent (%)</th>
<th>Lab made <em>rabri</em></th>
<th>Market <em>rabri</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids</td>
<td>50.80</td>
<td>49.84</td>
</tr>
<tr>
<td>Moisture</td>
<td>49.20</td>
<td>50.06</td>
</tr>
<tr>
<td>Fat</td>
<td>16.10</td>
<td>12.90</td>
</tr>
<tr>
<td>Lactose</td>
<td>11.80</td>
<td>11.48</td>
</tr>
<tr>
<td>Sucrose</td>
<td>11.90</td>
<td>12.29</td>
</tr>
<tr>
<td>Total proteins</td>
<td>10.01</td>
<td>NA</td>
</tr>
<tr>
<td>Ash</td>
<td>1.99</td>
<td>NA</td>
</tr>
<tr>
<td>Titratable acidity</td>
<td>0.31</td>
<td>NA</td>
</tr>
</tbody>
</table>

12.4 Microbiological Quality of *Rabri*
Microbiological quality of *rabri* that is sold in market is given in Table 12.2.

**Table 12.2 Microbiological quality of *rabri***

<table>
<thead>
<tr>
<th>Microbial count/g</th>
<th>Market samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable plate count</td>
<td>24.7 x 10³</td>
</tr>
<tr>
<td>Coliform count</td>
<td>202</td>
</tr>
<tr>
<td>Yeasts and mould count</td>
<td>72</td>
</tr>
</tbody>
</table>

12.5 Sensory Quality of *Rabri*
It was observed that *rabri* having slightly cooked flavor and pleasant sweet creamy taste is liked most by the consumers. The samples having more layers of *malai* along with some liquid portion were rated high in market. *Rabri* samples having light yellow and white colour with slight tinge of browning are more preferred by the consumers.
12.6 Changes in Milk during Manufacture of Rabri
The following changes occur in milk due to prolonged heating during preparation of rabri.
- The viscosity of milk increases
- There is a gradual lowering of pH with corresponding increase in acidity of the product.
- Minerals, specially calcium and phosphorus get trapped in clotted cream part.
- Depending on the intensity and duration of heat treatment, browning intermediates are formed in varying degrees.
- Due to release of -SH groups, a cooked flavor develops in the product.
- A considerable loss of heat sensitive vitamins occurs during the preparation of the product.
- Both casein and whey proteins get denatured as a function of heat and increased concentration of total solids.

12.7 Yield
Yield of rabri depends on total solids of milk, ratio of concentration of milk and amount of sugar added. In general 25-28 per cent yield can be expected from buffalo milk.

12.8 Shelf Life
Rabri can keep well for about 2-3 days at room temperature and 10-15 days at refrigeration temperature.
Lesson 13
*BASUNDI* - PRODUCT DESCRIPTION, METHOD OF PREPARATION, YIELD, PACKAGING AND SHELF LIFE

13.1 Introduction
*Basundi* is known to have been prepared over several centuries in the western and southern parts of India. It is served during special festivities such as weddings and religious functions.

13.2 Product Description
*Basundi* is a heat-desiccated, thickened milk dessert, having white to light caramel colour, creamy consistency with soft textured flakes that are uniformly suspended throughout the product matrix. *Basundi* has a sweetish caramel aroma. Consumed directly as a dessert, it contains all the solids of milk in an approximate two-fold concentration and sugar, which gives it high nutritive value. Additives increase the calorific value of the product. The chemical composition of the market samples of *basundi* is given in Table 13.1

| Table 13.1 Composition of *basundi* |
|-------------------------------|------------------|
| **Constituent**   | **Range %**   |
| Fat              | 12-15          |
| Protein         | 7-9            |
| Lactose         | 9-11           |
| Ash             | 1.3-1.5        |
| Sugar           | 20-22          |
| Total solids    | 49-57          |

The manufacture of *basundi* is confined to the non-organized sector. Its traditional method of production is labour-intensive and energy inefficient. There are variations in the product profile from region to region. Standardization of the traditional process in terms of manufacturing techniques, sensory profiles, and compositional and physico-chemical attributes is necessary for attaining a product of uniform standard and assured quality.

13.2.1 Size of Industry
The total production of *basundi*, estimated at 25,000 tonnes per annum (Aneja et al., 2002), is mainly confined to the cottage scale in the non-organized sector. *Basundi* is a popular milk dessert in Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu.

13.3 Technology
Buffalo milk is preferably used for *basundi* owing to its high total solids content. Traditionally it is prepared by heating whole milk in a pan over fire. Milk is thickened through evaporative heating with occasional scraping at the bottom. With progressive boiling, more and more thickening of milk occurs. The milk is concentrated to the consistency of the condensed milk and sugar (about 15-17% of concentrated milk) is added and stirred into the milk until it is fully dissolved.
The pan is removed from the fire, allowed to cool and the flavouring material is added. Powdered cardamom (about 0.02% of concentrated milk) is added and mixed, along with saffron and borneol (edible camphor) (about 0.02% each of concentrated milk) and stirring continued till the desired consistency is achieved. The end-product has a pleasant caramel flavour and thick consistency. It is usually served chilled.

13.4 Physico-Chemical Characteristics

*Basundi* has a white to light brown colour with a pleasant caramelized flavour. It is of a creamy consistency and has a viscous body. Its chemical composition depends on the initial composition of milk, the degree of concentration of milk solids and the quantity of sugar added.

13.5 Innovations

It is recommended that the fat content of milk is standardized to about 5 percent in case of buffalo milk and about 4 percent in case of cow milk (fat : SNF ratio of about 0.5). Homogenization of milk at 75 kg/cm$^2$ at 65°C imparts a distinctively superior and rich body to the finished product. Milk may be concentrated by the Scraped Surface Heat Exchanger (thin film) when the product is made by the mechanized process. Alternatively, skim milk may be preheated to 90°C in a plate heat exchanger and concentrated by the Reverse Osmosis process to 22 percent TS level. Then, cream is mixed to this milk concentrate for adjustment of the fat content.

Conventional vacuum evaporator may also be employed for concentration of milk to a predetermined level. For consumer-level marketing, the final product may be packaged in glass bottles, heat-sealable polypropylene cups with aluminium foil lids, metalized poly laminated pouches. Bulk packaging is used for institutional markets. For manufacture of long shelf life *basundi*, the UHT processing may be employed for the milk concentrate, followed by aseptic packaging.

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Module 6. Payasam /Kheer

Lesson 14
PAYASAM/KHEER – VARIETIES, METHOD OF PREPARATION, YIELD, PACKAGING AND SHELF LIFE

14.1 Introduction
Cereal mixed indigenous milk products are popular all over India. In this category, the variety depends on the regions e.g. Kheer in Northern India, Payasam in Southern India. The name of the payasam / kheer changes with the additive cereal and other additives added viz. rice payasam, saboodana payasam, semya / Semolina payasam, kaddu-ki-kheer etc.

14.2 Product Description
Kheer is a heat concentrated milk based confection with added cereals, sugar, nuts and dry fruits. The different varieties of kheer and payasam are

- Rice kheer
- Saboodana payasam
- Semya / Semolina payasam
- Kaddu-ki-kheer
- Khas-Khas kheer
- Rava - payasam
- Coconut - kheer
- Lauki-ka-kheer
- Green gram dal payasam
- Bengal gram dal payasam

14.3 Method of Preparation
Buffalo milk is preferred for both payasam and kheer preparation. Standardized buffalo or cow milk with 4.5%-5.5% fat and 8.5 to 9% SNF is taken in a pan and boiled on a non smoky fire. Good quality rice is taken, washed and added to milk @ 2.5%. Gentle boiling accompanied by thorough stirring cum scraping of the contents is undertaken. When the ratio of concentration of milk reaches 1: 1.8, sugar is added @ 5-7.5% of the milk taken. Further heating with stirring is continued until the rice is properly cooked and approximately when the concentration reaches 2 to 3 times. Powdered cardamom (@0.02%) is mixed as flavoring at the end of heating.

14.4 Chemical Composition of Kheer
Chemical composition of kheer depends on

- Kind of milk (cow/buffalo/mixed)
- Quality of milk
- Ratio of concentration
- Quality and type of cereals/pulses optional ingredients.
Table 14.1 Chemical composition of *kheer*

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>67.02</td>
</tr>
<tr>
<td>Fat</td>
<td>7.83</td>
</tr>
<tr>
<td>Protein</td>
<td>6.34</td>
</tr>
<tr>
<td>Lactose</td>
<td>8.45</td>
</tr>
<tr>
<td>Sucrose</td>
<td>8.95</td>
</tr>
<tr>
<td>Ash</td>
<td>1.41</td>
</tr>
</tbody>
</table>

14.5 Keeping Quality of *Kheer*

The average shelf life of *kheer* at 37 °C ± 1°C is 2-3 days and 10-15 days at 4 °C ± 1 °C.

14.5.1 Extension of shelf life of *kheer*

Successful attempts made to improve the shelf life of *kheer* are given below:

14.5.1.1 Addition of nisin

Addition of Nisin at the end of preparation could extend the shelf life of *kheer* upto 8-10 days at 37°C ± 1°C and 100-150 days at 4 ± 1°C.

14.5.1.2 Sterilization

*Kheer* packed in tin cans when heat treated by immersing in boiling water for 20 minutes, could keep well for 3-4 days at room temperature and 60-70 days at 4 ± 1 °C. The shelf life of canned *kheer* manufactured, cooked and sterilised simultaneously was extended to six months at 30°C.

14.6 Dried *Kheer Mix*

Production of *kheer* in a dry form suitable for ready reconstitution will extend the shelf life of the product.

14.6.1 Method of preparation

Fresh buffalo milk is standardized to 6.9 % fat and and 9.5% SNF. The milk is preheated at 60°C for 15 min in the preheater of triple effect evaporator and then concentrated to 35% TS. Homogenisation of milk concentrate is done at a pressure of 183 bar in the first stage and 36 bar in the second stage. Then it is mixed with ground rice and sugar and slurry is heated to a temperature of 80 °C for gelatinizing of rice in a steam jacketed vessel. Using a fluidized bed dryer the slurry is dried and instantized. The product is packed in metalized polyester LDPE bags. Reconstitution of *kheer* mix involves rehydration of instant rice in boiling water for 10 min followed by dispersal of the powdered component into the rice water mixture. Then the product is garnished with dry fruits, flavors etc.
Fig. 14.1 Flow diagram of preparation of dried *kheer* mix
Lesson 15

CHANNA – DEFINITION AND PRODUCT DESCRIPTION, METHODS OF PREPARATION

15.1 Product Description

Chhana is an acid coagulated product obtained from milk. The curd mass obtained when milk is coagulated with the organic acids such as citric acid, lactic acid at higher temperature and after subsequent drainage of whey, mass of curd obtained is called chhana. It looks off-white, tastes mildly acidic, and has characteristic spongy texture.

According to FSSR-1511 chhana means the product obtained from the cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70.0 per cent moisture and the milkfat content shall not be less than 50.0 per cent on dry matter. Milk solids may also be used in preparation of this product.

Low fat chhana shall conform to the following requirements:—
(i) Moisture Not more than 70.0 percent
(ii) Milk fat Not more than 15.0 percent of dry matter:
Further it says that such low fat chhana shall be sold in sealed package only.

Chhana is mainly prepared from cow milk and used for preparation of varieties of Bengali sweets. About 4 to 4.5% of the total milk produced in India is used for chhana making. Chhana is used as a base for the preparation of a variety of sweets like sandesh, rasogolla, chamcham, rasomalai, pantoa, chhana murki, etc. Following table (Table: 15.1) depicts the chemical composition of chhana. Table 15.2 reveals the partitioning of milk solids in chhana and its whey.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cow milk chhana</th>
<th>Buffalo milk chhana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture %</td>
<td>53.4</td>
<td>51.7</td>
</tr>
<tr>
<td>Fat %</td>
<td>24.8</td>
<td>29.7</td>
</tr>
<tr>
<td>Lactose %</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Protein %</td>
<td>17.4</td>
<td>14.4</td>
</tr>
<tr>
<td>Ash %</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>pH</td>
<td>5.7</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Source: R.P. Aneja et al., 1502
Table 15.2 Partitioning of milk solids in *chhana* and its whey prepared from cow milk

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Milk</th>
<th>Chhana</th>
<th>Chhana Whey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>87.34</td>
<td>53.20</td>
<td>93.42</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>3.50</td>
<td>24.70</td>
<td>0.42</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>3.62</td>
<td>17.82</td>
<td>0.44</td>
</tr>
<tr>
<td>Lactose (%)</td>
<td>4.86</td>
<td>2.20</td>
<td>5.12</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>0.68</td>
<td>2.08</td>
<td>0.60</td>
</tr>
<tr>
<td>T.S. (%)</td>
<td>12.66</td>
<td>46.80</td>
<td>6.58</td>
</tr>
<tr>
<td>SNF (%)</td>
<td>9.16</td>
<td>22.10</td>
<td>6.16</td>
</tr>
</tbody>
</table>

It is reported that *chhana* retains about 90% fat and protein, 50% mineral and 10% lactose of the milk from which it has been made and it also reported that, *inchhana* it is possible to recover 52 – 61% of milk solids originally being present in the milk.

15.2 Methods of Manufacturing

15.2.1 Traditional method of manufacture

*Chhana* has been prepared by boiling about 15-40lit of cow milk in a steel pan. Acidic whey (previous day whey) added to boiling hot milk serve as coagulant with continuous stirring till the completion of coagulation. Contents poured over a muslin cloth held over another vessel. Whey is collected in a vessel. Muslin cloth containing curd mass washed with potable water by immersion process and allowed to drain for 30min to expel free whey.

15.2.2 Industrial production of *Chhana* from cow milk

In industrial production, multi-purpose stainless steel vats or storage tanks are used for storage of milk, plate heat exchanger or steam jacketed kettle are used for heating of milk. Other process controls like temperatures of heating of milk, coagulation and coagulant are very precisely maintained as shown in flow diagram depicted below (Fig. 15.1). SS strainers with cloth lining are used to filter the whey out of coagulum.
15.2.3 Mechanized system for chhana making

A prototype machine with a capacity to produce 40 kg of chhana/hour has been developed at NDRI, Karnal. The equipment consists of 1) Balance tank 2) Injection chamber 3) holding coil 4) Cooling chamber and 5) a strainer.

The standardized cow milk is pumped from balance tank at the rate of 250 lit of milk/ hr to an injection chamber where culinary live steam (at 1 kg/cm² pressure and at the rate of 65kg/hr) is directly injected into the milk. The steam gets completely condensed in milk and the temperature is raised to 90-95°C. Thereafter, the milk is brought in contact with sour whey, the quantity of which is regulated in proportion to the rate of milk flow. The mixture of whey and milk is circulated through a holding coil (8m length X 10mm diameter) to facilitate complete coagulation of milk. The coagulated product along with whey is then pumped into a double jacketed cooling tank, where it is cooled down to room temperature. Finally the product is taken to mechanical strainer wherein inclined sieve situated to drain the whey thoroughly. Chhana with 55-65% moisture is discharged through the outlet and collected in the container. Drained whey is transferred to a holding tank for souring for subsequent use.
Recently, workers at Indian Institute of Technology, Kharagpur developed a continuous chhana-making unit of 60 L/h of milk capacity. The unit has a duplex plunger pump for dosing of milk and acid. Helical coil heat exchanger was used to heat milk prior to acid coagulation. It also consists of a vertical column that gives residence time for the separation of milk solids to chhana.

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Lesson 16
PREPARATION OF CHHANA FROM BUFFALO MILK

16.1 Introduction

In India about 53% of the total milk produced is from buffaloes. Dairy plants prefer to buy buffalo milk as it contains higher proportion of fat and total solids, approximately 1.5 to 2.0 times more fat than cow milk. Because of many inherent differences in physico-chemical makeup of cow and buffalo milk, several problems are encountered during processing of buffalo milk. Calcium content has direct correlation with hardness of chhana. The high calcium and casein (cow milk contains 110mg calcium and 2.42 - 2.7% casein and buffalo milk contains 170mg calcium and 2.6 - 3.38% casein per 100g milk) contents in buffalo milk render it unfit for preparation of most chhana based sweets. Few attempts have been made to produce chhana from buffalo milk.

A mixture of buffalo milk and cow milk in the ratio of 1:3 yields chhana with soft body and smooth texture which is desired feature of chhana for rasogolla and sandesh preparation.

Addition of mixture of sodium diphosphate (75g per 100lit.) and disodium phosphate (58g per 100lit.) followed by storing the hot milk for some time before precipitation produces a soft chhana. Sodium citrate converts some of the insoluble calcium into soluble salts in buffalo milk and this helps in production of softer chhana.

Dilution of buffalo milk (standardized to 4% fat) with potable water @ 30% of milk after boiling and coagulating at 70°C using 0.5% citric solution produces chhana good for sandesh making.

16.2 Factors influencing quality of chhana

16.2.1 Type of milk

Cow milk produces chhana with moist surface, light yellow colour, soft body, smooth texture and mildly acidic flavour which is more suitable for sweet preparation than buffalo milk chhana. Buffalo milk produces chhana with hard body and coarse texture, with white colour and greasy surface. Sweets prepared from buffalo milk chhana are hard, coarse and less spongy. Colostrum milk produces pasty Chhana with deeper yellow colour and unsuitable for rasogolla production.

16.2.2 Quality of milk

16.2.2.1 Fat level

Minimum 3.5 to 4% fat in cow milk and 5% fat in buffalo milk gives a satisfactory body and texture in chhana. Lower than 3.5% fat leads to hard body and coarse texture while higher fat level results in greasy surface.

16.2.2.2 Acidity

Acidic milk produces chhana with sour smell and bitter taste hence unfit for sweet making. Addition of neutralizer to slightly acidic milk helps in getting chhanasuitable for sandesh and not for rasogolla. Milk with 0.25-0.28% LA can be used by adding 0.2% Sodium Citrate followed by thorough washing of the coagulum.

16.2.3 Type, strength and quantity of coagulant

16.2.3.1 Type

Organic acids, like citric acid, lactic acid or sour whey are normally used. Lactic acid produces granular chhana suitable for rasogolla making. Citric acid gives pasty texture suitable for sandesh making.
However, dilute solution of citric acid can also be used for making chhana suitable for rasogolla. Sour whey with (0.9% LA) can also be used for producing good quality chhana. Calcium lactate produces chhana with bright white colour, soft body and smooth texture and pleasant flavour and most suitable for sandesh making.

16.2.3.2 Strength

Low acid strength (0.5%) results in very soft body and smooth texture suitable for rasogolla but unsuitable for sandesh making. The optimum strength of coagulant should be between 0.5 to 0.8% citric or lactic acid to produce good quality chhana suitable for making both rasogolla and sandesh. However, calcium lactate of 4% solution produces most satisfactory quality chhana.

16.2.3.3 Quantity

The quantity of coagulant required is dependent on the type of milk. Generally, 2 to 2.5 g of citric acid per kg of fresh milk and 2.5 to 3.9 gm of lactic acid and 6 to 12 gm of calcium lactate per kg are required individually for complete coagulation.

16.2.4 Temperature and pH of coagulation

As the coagulation temperature decreases, the moisture content of chhana increases resulting in softer body and smooth texture. Higher coagulation temperature imparts graininess and hardness to chhana. Optimum coagulation temperature of cow milk is 80 to 85°C and pH is 5.4 and that of buffalo milk is 70 to 75°C and pH is 5.7.

16.2.5 Speed of stirring during coagulation

Higher speed of stirring during coagulation reduces the moisture content of chhana and increases its hardness, optimum speed is 40-50 rpm.

16.2.6 Method of Straining

Delayed straining produces a soft and smooth texture chhana than immediate straining. Delayed straining gives a higher proportion of moisture, yield, recovery of milk solids and lower hardness. Delayed straining is recommended for buffalo milk.

16.2.7 Effect of heat treatment given to milk

The recovery of milk solids and yield of chhana is influenced by the heat treatment given to milk prior to acidification. The heat treatment prior to acidification involves temperature to which milk is heated, the rate of heating, temperature to which milk is cooled and the rate of cooling. Several heat induced changes occur during heating; denaturation of whey proteins and their subsequent association with casein micelles, precipitation of calcium phosphate onto the casein micelles and dissociation of κ-casein from the micelle. The degree of denaturation of whey proteins depends on time temperature combination during heating and is mainly determined by maximum temperature to which milk is heated. Whey protein denaturation at above 70°C is two step process, first an infolding of whey proteins takes pace followed aggregation. α-lactalbumin shown the higher resistance to denaturation and it reported that 95°C temperature denaturates all the whey proteins.

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Lesson 17

YIELD OF CHHANA-PACKAGING AND PRESERVATION OF CHHANA, SHELF LIFE AND DEFECTS

17.1 Yield of chhana

Yield and quality of chhana depends on the type of milk, heat treatment given to milk prior to acidification, acidity of milk, coagulation temperature, strength of coagulant and residence time of the coagulated chhana-whey mixture before separation of coagulated milk solids from whey.

Total solids present in milk especially fat and casein influence the yield of chhana, which from cow milk is 15 to 17% and from buffalo milk is 81 to 20%.

17.2 Shelf life of chhana

Chhana is an extremely perishable due to its high moisture content. At room temperature, it does not keep longer than a day. Under refrigeration, the shelf life can be extended up to six days. Packaging materials used to pack chhana have a role in extending the shelf life. The cow milk and buffalo milk chhana stored in tin cans and cellulose film/LDPE was found acceptable upto 3days at 37°C, and 20days at 4-5°C. Since fresh chhana is preferred for making sweets of good quality not much research efforts have been made for extending the shelf life.

17.3 Packaging of Chhana

Due to the high heat treatment during the production of chhana, the microbial load is very low in fresh products. It is the post processing contamination that takes place during handling and storage, which leads to sharp increase in the population of spoilage and pathogenic microorganisms. Packaging plays an important role to protect and preserve the quality of the products for long time. At present chhana is manufactured in rural households and packaged in bamboo baskets lined with leaves or parchment paper or polyethylene film and it is locally sold to retailers. This kind of packaging is not effective and adequate. Chhana should be protected from microbial contamination, light and oxygen using appropriate packaging system. Vegetable parchment paper can be used for packaging of chhana but not so effective in extending the shelf life. Chhana packed tin cans showed maximum protection against chemical deterioration. Cellulose film/LDPE laminates and alluminium/LDPE laminates also exhibit maximum protection to chhana against chemical deterioration. Most of the chhana is used for making chhana based sweets, and prepared freshly whenever it is required.
17.4 Defects in Chhana

### 17.4.1 Flavour defects

<table>
<thead>
<tr>
<th>Defect</th>
<th>Causes</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoky</td>
<td>Use of smoky fire for boiling of milk</td>
<td>Use non smoky fire for boiling of milk</td>
</tr>
<tr>
<td>Sour</td>
<td>Use of high acid milk. Use excessive amount of coagulating acid / sour-whey</td>
<td>Use fresh milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use proper amount of coagulant</td>
</tr>
<tr>
<td>Rancid</td>
<td>Fat hydrolysis due to lipase action during storage (at room temperature or above)</td>
<td>Store chhana at low temp (4 to 6°C)</td>
</tr>
<tr>
<td>Stale</td>
<td>Excessively long period of storage of chhana at low temp (5-10°C)</td>
<td>Control microbial growth and early utilization.</td>
</tr>
</tbody>
</table>

### Body & texture defects

<table>
<thead>
<tr>
<th>Defect</th>
<th>Causes</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Body</td>
<td>Inadequate fat content in milk used for chhana production.</td>
<td>Use optimum fat content in milk</td>
</tr>
<tr>
<td></td>
<td>Inadequate moisture content of chhana due to faulty production</td>
<td>Maintain proper moisture content of chhana by adapting correct production technique</td>
</tr>
<tr>
<td>Coarse Texture</td>
<td>Use of high acid milk. Inadequate fat content in milk</td>
<td>Use fresh milk</td>
</tr>
<tr>
<td></td>
<td>Too-high temperature of coagulation</td>
<td>Keep optimum fat content in milk</td>
</tr>
<tr>
<td></td>
<td>Too-low pH. of coagulation</td>
<td>Coagulate at optimum temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coagulate at optimum pH</td>
</tr>
</tbody>
</table>

### Colour & appearance defects

<table>
<thead>
<tr>
<th>Defect</th>
<th>Causes</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouldy Surface</td>
<td>Long storage of chhana, especially in humid atmosphere</td>
<td>Pack the product immediately and reduce the exposure to air</td>
</tr>
<tr>
<td></td>
<td>Excessive moisture content in chhana</td>
<td>Maintain proper moisture content of chhana</td>
</tr>
<tr>
<td>Visible dirt / foreign matter</td>
<td>Incorrect or no clarification/filtration of milk</td>
<td>Follow the clarification/filtration method with suitable filters</td>
</tr>
<tr>
<td></td>
<td>Improper cleaning of utensils/equipments</td>
<td>Clean the utensils/equipments properly</td>
</tr>
<tr>
<td></td>
<td>Dirty / windy surroundings during manufacture</td>
<td>Manufacture chhana under hygienic conditions</td>
</tr>
<tr>
<td></td>
<td>Transport of unpacked chhana</td>
<td>Pack chhana in air tight containers and then transport</td>
</tr>
</tbody>
</table>
Lesson 18

RASOGOLLA - PRODUCT DESCRIPTION – PREPARATION, QUALITY- PACKAGING AND SHELF LIFE

18.1 Introduction

Rasogolla popularly known as king of Bengal sweets. Product was developed by Nobin Chandra Das in 1868. Production is largely confined to cottage and small scale industry. K.C. Das used to be a brand name for rasogolla in past. At present many industries like Bikaner, Haldiram Foods etc., produce the product. Export markets for canned rasogolla are US, some part of Europe, and UAE. Canning helps to expand distribution of rasogolla in domestic and international markets.

18.2 Product description

Rasogolla resembles ping-pong ball in shape, snow-white in colour and possesses a spongy, slightly chewy body and juicy and smooth texture. Rasogolla balls are stored and served in sugar syrup. The product is flavoured with kewara, pista and rose and sometimes centered with cardamom or pista.

18.3 Rasogolla preparation

Rasogolla is prepared from soft, fresh cow milk chhana. Kneading of chhana to smooth paste by manually or using planetary mixer is first step in Rasogolla making. The smooth paste is portioned and rolled between palms to form balls of about 15mm diameter each weighing about 8 – 10g in weight. Each ball should have smooth surface without visible cracks on surface. On an average, one kg chhana yields 90 – 100 rasogolla balls. These rasogolla balls are cooked in sugar syrup of approximately 50° brix. Heating is regulated to maintain stability of the balls. Balls are cooked for 14 – 15 min. During cooking small amount of water is continuously added to maintain syrup concentration. This makes up for the loss of water due to evaporation. About 10% of sugar syrup should be replaced with fresh one each time to cook another batch. After cooking rasogolla balls are transferred to dilute sugar syrup at 60° C for texture and colour improvement. After 30min stabilized balls are transferred to 60° brix syrup for 1-2 hours, followed by final dipping in 50° brix syrup. Chemical composition of rasogolla is given in Table 18.1

Table 18.1 Chemical composition of rasogolla

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameter</th>
<th>Rasogolla made from cow milk</th>
<th>Rasogolla made from buffalo milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Moisture (%)</td>
<td>54.0 – 56.0</td>
<td>41.5 – 42.1</td>
</tr>
<tr>
<td>2</td>
<td>Total solids (%)</td>
<td>44.0 – 46.0</td>
<td>57.9 – 58.5</td>
</tr>
<tr>
<td>3</td>
<td>Protein (%)</td>
<td>5.0 – 5.2</td>
<td>5.3 – 5.8</td>
</tr>
<tr>
<td>4</td>
<td>Fat (%)</td>
<td>4.8 – 5.0</td>
<td>7.8 – 8.0</td>
</tr>
<tr>
<td>5</td>
<td>Carbohydrate (%)</td>
<td>33.6 – 35.1</td>
<td>43.6 – 44.1</td>
</tr>
<tr>
<td>6</td>
<td>Ash (%)</td>
<td>0.75</td>
<td>0.7</td>
</tr>
<tr>
<td>7</td>
<td>pH</td>
<td>6.50 - 6.70</td>
<td>6.67 - 6.79</td>
</tr>
</tbody>
</table>

18.3.1 Preparation of cooking medium

Sugar syrup preparation includes dissolution of sugar in water and boiling till it is concentrated to desired brix level. While boiling, scum appearing on top of the surface is scooped off before cooking the rasogolla balls. Pinch of milk can be added during boiling to remove the scum.

Following table listed the BIS standards for rasogolla

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>45 – 55%</td>
</tr>
<tr>
<td>Milk fat, minimum</td>
<td>5%</td>
</tr>
<tr>
<td>Sucrose, maximum</td>
<td>45%</td>
</tr>
<tr>
<td>Protein, minimum</td>
<td>5%</td>
</tr>
<tr>
<td>Acidity of syrup (ml of N/10 NaOH required to neutralize 100ml of the syrup), maximum</td>
<td>6</td>
</tr>
<tr>
<td>Concentration of syrup, maximum</td>
<td>55° Brix</td>
</tr>
<tr>
<td>Bacterial count, per gram, maximum</td>
<td>500</td>
</tr>
<tr>
<td>Coliform count, per gram</td>
<td>Nil</td>
</tr>
</tbody>
</table>

18.4 Mechanized production of Rasogolla

Mechanical disc grinder has been designed for better kneading of chhana. Screw conveyor with kneading section and cutter provided at the exit simultaneously perform the kneading and portioning of chhana into...
lumps of about 10g each. This lump is allowed to fall on a spinning disc, which has a stationary mounting above it. Rotation of lumps of *chhana* with stationary mounting forms it into the spherical balls. Recently rotating plate over a conveyor belt is also in use for ball formation. Now these balls can be made to fall directly into sugar syrup for cooking. Alternatively mechanized cooker can also be used for cooking; advantages are uniform weight and shape of *rasogolla* balls, large production, and uniform quality.

### 18.5 Yield of Rasogolla

90-100 *rasogolla* balls of diameter 30mm can be made from one kg of *chhana*. The yield is 254g (drained weight) of *rasogolla* per 100g of cow milk *chhana* and 342g of *rasogolla* per 100g of buffalo milk *chhana*.

### 18.6 Packaging of Rasogolla

Balls are usually packed hot at 90°C in lacquered tin cans of 1kg capacity. [Empty containers are first sterilized in hot air inside closed chamber. *Rasogolla* balls with hot sugar syrup and permissible preservatives (Sorbic acid and its sodium, potassium and calcium salts calculated as sorbic acid – maximum 1000 ppm and Benzoic acid maximum 300ppm) are filled into containers and pass through steam chest]. After seaming, the containers are transferred to chilled water to create partial vacuum by quick condensation of the vapours inside the container.

### 18.7 Shelf life of Rasogolla

*Rasogolla* can be store for 2 – 3 days at room temperature without any packaging and added preservatives. Shelf life of *rasogolla* in tin cans is reported to be 6 months.

******* ☺ *******
Lesson 19
SANDESH – VARIETIES-METHOD OF PREPARATION-QUALITY-PACKAGING AND SHELF LIFE

19.1 Introduction
Sandesh is popular chhana based sweet delicacy of eastern parts of India mainly West Bengal. Sandesh is preferably prepared from cow milk chhana because it yields soft body and smooth texture with fine and uniform grains. Sandesh prepared from buffalo milk exhibited hard body and coarse texture. Chhana obtained with citric acid is usually preferred for the manufacture of sandesh. “kachagolla”(sweetened chhana) with high moisture is a soft grade product formed into various shapes and sizes using appropriate moulds. Various sweeteners are used like sugarcane jaggery, Date jaggery and palm jiggery (Nolen Gur) in addition to cane sugar. It is also flavoured with essences of jackfruit, orange, rose etc. Sandesh has a firm body and smooth texture. It is a rich source of milk proteins, fat, sucrose and fat soluble vitamins apart from rich aroma.

19.2 Varieties of Sandesh
There are three varieties of sandesh, namely;

19.2.1 Raw grade (kachagolla)
Kachagolla as the name depicts has chhana like flavour, moist appearance, soft body and coarse grainy texture.

19.2.2 Soft grade (Naram – pak)
It is the most common variety, possessing soft body and smooth texture with fine grains uniformly distributed and relatively lower amount of sugar and high moisture in it.

19.2.3 Hard grade (kara-pak)
It has a firm body, dry appearance and low moisture content.

19.3 Method of preparation of Naram-pak sandesh
Chaana is the base material for preparation of sandesh. Chhana is then kneaded or ground using a mechanical grinder to make smooth paste of chhana. About 30 to 45% of sugar is added into one portion of chhana and the mixture heated upto 75°C with continuous stirring and scrapping results in pat formation in the product. The second part of chhana is added at this stage. Addition of flavour and colour is optional and added according to local preference. This pat will be moulded to different shapes. Detailed manufacturing process of sandesh preparation is shown in flow diagram 19.1.
19.4. Chemical composition of sandesh

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Sandesh (soft grade) prepared from cow milk chhana</th>
<th>Sandesh prepared from buffalo milk chhana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture(%)</td>
<td>25.5</td>
<td>27.14</td>
</tr>
<tr>
<td>Fat(%)</td>
<td>19.89</td>
<td>18.42</td>
</tr>
<tr>
<td>Protein(%)</td>
<td>18.48</td>
<td>18.71</td>
</tr>
<tr>
<td>Ash(%)</td>
<td>1.66</td>
<td>1.90</td>
</tr>
<tr>
<td>Sugar(%)</td>
<td>34.47</td>
<td>33.83</td>
</tr>
</tbody>
</table>

Source: Sen & Rajorhia 1991
19.4.1 Composition of soft grade *sandesh* and hard grade *sandesh* procured from Kolkata market

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Soft grade <em>sandesh</em></th>
<th>Hard grade <em>sandesh</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture(%)</td>
<td>21.23-19.15</td>
<td>12.27-15.23</td>
</tr>
<tr>
<td>Fat(%)</td>
<td>16.19-17.77</td>
<td>16.26-18.11</td>
</tr>
<tr>
<td>Protein(%)</td>
<td>16.21-18.62</td>
<td>16.22-19.83</td>
</tr>
<tr>
<td>Ash(%)</td>
<td>1.22-1.81</td>
<td>1.62-1.66</td>
</tr>
<tr>
<td>Sugar(%)</td>
<td>37.25-38.99</td>
<td>42.31-47.68</td>
</tr>
</tbody>
</table>

Source: Chakrabarti *et al.*, 2001

19.5 Texture description of *sandesh*

Soft grade *sandesh* has characteristic soft cohesive body and smooth texture with small size grains, whereas hard grade *sandesh* has a firm crumbly, coarse, gritty and chewy texture with big grains. It is reported that buffalo milk *sandesh* is slightly less cohesive, springy, gummy and chewy than cow milk *sandesh*.

19.6 Factors controlling the quality of *sandesh*

19.6.1 Fat content in milk

Fat content in milk has prominent role in production of good quality of *sandesh*. It is reported that soft grade *sandesh*, prepared from cow milk with 4% fat is most suitable due to rich appearance, soft body, smooth texture and pleasant flavor. *Sandesh* made from cow milk with 2% fat exhibited dry appearance and coarse texture, therefore optimum fat level has to be maintained in milk to make best quality *sandesh*.

19.6.2 Moisture content in *sandesh*

Moisture content and sugar level varies with the grade of *sandesh*, hard grade *sandesh* has low moisture content and higher sugar level and vice versa with soft grade *sandesh*. It is reported that 30% sugar is optimum for the good quality *sandesh*. Moisture content and duration of heating facilitates the dissolution rate of sugar. Addition of ground sugar helps in reducing the heating time thus saves the heating energy.

19.7 Packaging and shelf life of *sandesh*

Paperboard cartons, polystyrene containers, high-density polyethylene bags, nylon-6 pouches and tin cans are commonly used for packaging of *sandesh*. A storage study conducted by Sen, D. C. and Rajorhia, G. S. revealed that maximum chemical, microbiological and organoleptic deterioration takes place in *sandesh* samples packaged in the folding paperboard cartons. At 30±1°C with 70% RH the product can be stored up to 5 days only whereas at 7±1°C with 90% RH *sandesh* remained acceptable for up to 30 days in folding paperboard cartons and 45 days in tin cans. Acceptability of *sandesh* decreased during storage, mainly due to flavour deterioration.

******** ☺ *******
PREPARATION OF RASOMALAI, RAJBOGH, PANTOOA, CHHANA PODO

20.1 Rasomalai

Rasomalai is chhana based product, prepared in a similar way as rasogolla upto ball formation stage, followed by flattening the balls and cooking. These flattened balls are soaked in thick concentrated sweetened milk or rabri. Rasomalai is marketed as flattened chhana patties floating in thickened sweet milk. It is very delicate, chewy and spongy sweet. It tastes better when served chilled.

20.1.1 Method of preparation

Chhana is kneaded into smooth dough along with 1 to 4 % wheat flour. Dough is portioned and rolled into balls having a smooth texture without cracks. These balls are flattened to differentiate from rasogolla balls. Flattened balls are processed like rasogolla and subsequently stored in sweetened (5 – 6% sugar) milk thickened to one third of its volume. Rabri without the creamy layer can also be used instead of thickened milk to soak the cooked flattened balls. Rasomalai has limited shelf life of 3-5 days at refrigerated temperature.

Milk

Evaporation/ concentration (50%of its original volume)

Addition of sugar (4%of original milk)

Addition of flat rasogolla

Heating (2-5min)

Cooling/chilling

Packaging

Storage at <5°C

20.2 Rajbhog

Rajbhog is a variety of rasogolla that is ballooned and larger in size than rasogolla. Diameter of these balls is around 50 – 60 mm. It is blended with saffron that imparts an attractive golden yellow shade to it. Chhana is kneaded into uniform dough, mixed with a small amount of saffron and portioned and shaped into balls which are almost twice the size as rasogolla. While shaping, a sugar ball or a cardamom seed or a nut is placed at the center of the balls. Balls are cooked in 50% solution of boiling sugar syrup till desirable body and texture is achieved. After that, balls are removed and wrapped (optional) in silver foil. A variation of rajbhog is kamalbhog that is blended with orange colour and flavour.
20.3 Chhana – murki

Chhana-murki is a sugar-coated sweet in the shape of small cubes. *Chhana* is kneaded and formed into 10mm thick flat slab. Same slab can also be prepared from paneer as well. It is then cut into small cubes of about 10mm cubes. Cubes are cooked in boiling sugar syrup in karahi for five min with gentle stirring. Slightly higher concentration sugar syrup is used to promote coating over the surface. Then karahi is removed from the fire and stirring is continued till the sugar is crystallized and coated uniformly over the cubes. Cubes are then cooled and sprinkled with flavour and colour and decorated with dry nuts flakes.

\[
\text{Chhana/ paneer} \\
\quad \downarrow \\
\text{Cutting into cubes (0.75-1.0 cm³)} \\
\quad \downarrow \\
\text{Cooking in sugar syrup (5min)} \\
\quad \downarrow \\
\text{Cooling and stirring} \\
\quad \downarrow \\
\text{Addition of flavor} \\
\quad \downarrow \\
\text{Packaging} \\
\quad \downarrow \\
\text{Storage (4-6°C)}
\]

20.4 Chhana podo

This is baked sweet, resembling milk cake and quite popular in Odhisa. Its surface has caramelized colour and flavour. *Chhana podo* is prepared by mixing chhana, sugar and semolina or maida. A paste is prepared and filled in shallow container or tray. Surface of the product is coated with ground sugar and covered with sal leaves. Burning coal is placed on the sal leaves & tray placed near the furnace to provide warmth for cooking. It makes the surface directly caramelized and imparts sweetish fragrance to the product. Further it is suggested that for better quality *chhana podo chhana* prepared 4% fat cow milk, 20% sugar and 5% maida (based on chhana) be mixed to prepare dough and it should be baked at 150° C for 80 min.(Sushma et al., 2010). The shelf life of *chhana podo* is only 3 days at 30°C while it is 35 days when vacuum packaged and stored at 6+1°C. (Kumar et al., 2002)

20.5 Chaana & Khoa Based Sweets

20.5.1 Pantooa

This is a chhana and khoa based product similar to gulabjamun. Equal quantity of khoa and chhana are broken into small bits. Maida and baking powder are also used in this product for obtaining smooth texture and soft body. After mixing maida and baking powder, broken bits of chhana and khoa are added into it. Small quantity of water is added to knead the above mixture and to form dough. From here onwards proceed similar to gulabjamun processing, i.e making balls and frying them in ghee or in oil, followed by dipping in sugar syrup. It has shelf life of 7 days at room temperature and 14 days at refrigerated temperature where as canned product can keep upto 6 months.
Equal quantity of khoa and chhana

\[ \text{Broken to small bits} \]

\[ \text{Baking powder + Maida} \rightarrow \text{Mixing \\& Kneading} \rightarrow \text{Water} \]

\[ \text{Frying in karahi at 125 to 130°C till deep brown in colour} \]

\[ \text{Balls are then transferred to sugar syrup} \]

\[ \text{Storage} \]

**Table 20.1** Proximate chemical composition of pantooa

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids%</td>
<td>57.7-68.3</td>
</tr>
<tr>
<td>Fat%</td>
<td>8-11</td>
</tr>
<tr>
<td>Protein%</td>
<td>6.7-7.9</td>
</tr>
<tr>
<td>Ash%</td>
<td>0.32-.53</td>
</tr>
<tr>
<td>Sucrose%</td>
<td>37.8-43.6</td>
</tr>
</tbody>
</table>

**20.5.2 Cham-Cham**

It is prepared from chhana with a firm body and close knit texture. It is coated with sugar or khoa. Process is similar to rasogolla. Balls are made and cooked in 50% sugar syrup, till desired body and texture get formed. Balls are removed and cut into halves. A layer of khoa is sandwiched between the two halves and its surface is coated with sugar or khoa powder before wrapping it in silver foil.
21.1 Product description

Paneer is a heat-acid coagulated milk product obtained by coagulating standardized milk with the permitted acids at specified temperature. The resultant coagulum is filtered and pressed to get the sliceable curd mass. Paneer has a firm, close, cohesive and spongy body and smooth texture. It is mainly prepared from buffalo milk and used for large number of culinary dishes. Though originally it was localized in Northern part of India but now it is preferred almost all parts of the country. Paneer is generally sold as blocks or slices, it is also referred as Indian fresh cheese. It is reported that about 5% of the milk produced in India is converted into paneer and paneer production is growing annually at the rate of 13%.

21.2 Chemistry of milk coagulation during paneer production

The phenomenon of coagulation involves formation of large structural aggregates and network of protein in which milk fat globules gets embedded. Acid and heat treatment causes the physical and chemical changes in casein. Heating causes interaction of ß-lactoglobulin with κ-casein and the complex formed between ß-lactoglobulin and α-lactalbumin. Acidification initiates the progressive removal of tri-calcium phosphate from the surface of the casein and it gets converted into mono-calcium phosphate. Further calcium is progressively removed from calcium hydrogen caseinate to form soluble calcium salt and casein. Colloidal dispersion of discrete casein micelles changes into large structural aggregates of casein. Under such a circumstance dispersion is no longer stable, casein gets precipitated and forms coagulum. Fat is embedded in the casein network.

21.3 Legal Standards

21.3.1 FSSR - 2011 standards of paneer

Paneer means the product obtained from the cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid, or citric acid. It shall not contain more than 70% moisture and milk fat content shall not be less than 50% of the dry matter. Milk solids may also be used in the preparation of paneer. Low fat paneer shall contain not more than 70% moisture and not more than 15% milk fat on dry matter basis. Microbial standards suggested by FSSR-2011 and BIS are given in Table 21.1 and Table 21.2 respectively.

<table>
<thead>
<tr>
<th>Total Plate Count</th>
<th>NMT 5,00,000/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coliforms</td>
<td>NMT 90/g</td>
</tr>
<tr>
<td><em>E.coli</em></td>
<td>Less than 10/g</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>Absent in 1g</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>NMT 100/g</td>
</tr>
<tr>
<td>Yeast and Mold count</td>
<td>NMT 250/g</td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>Absent in 1g</td>
</tr>
</tbody>
</table>

Note: NMT: Not more than
### Table 21.2 BIS Standards for paneer

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>BIS(IS:10484-1983, Reaffirmed 1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture % Max</td>
<td>60</td>
</tr>
<tr>
<td>Milk fat % by mass (dry matter basis) min.</td>
<td>50</td>
</tr>
<tr>
<td>Titratable acidity(as lactic acid), % by mass, max.</td>
<td>0.5</td>
</tr>
<tr>
<td>Total Plate Count</td>
<td>NMT 50,000/g</td>
</tr>
<tr>
<td>Coliform count, per g, Max</td>
<td>90</td>
</tr>
<tr>
<td>Yeast and Mould count per g, Max</td>
<td>250</td>
</tr>
</tbody>
</table>

#### 21.4 Method of manufacture

#### 21.4.1 Traditional method of manufacture

![Flowchart depicting traditional method of paneer manufacturing](image)

**Fig.21.1 Flowchart depicting traditional method of paneer manufacturing**
Buffalo milk is boiled in a bigger iron vessel and a small portion of this is transferred to a smaller vessel. The coagulant (usually sour whey) is added to hot milk and stirred with a ladle till coagulation is completed. The contents of the vessel are emptied over a piece of coarse cloth to drain off whey. The whole process is repeated till all the milk is coagulated. The curd is collected after draining the whey and pressed to remove more whey. Finally, product is then dipped in chilled water.

21.4.2 Industrial method for paneer making

![Flowchart depicting industrial method of paneer manufacturing]

Fig. 21.2 Flowchart depicting industrial method of paneer manufacturing
Buffalo milk is standardized to 4.5% fat and 8.5% SNF (standardize the buffalo milk to a fat: SNF ratio of 1:1.65). Milk is heated to 90°C without holding (or 82°C with 5 min holding) in a jacketed vat and cooled down to 70°C. Coagulation is done at about 70°C by slowly adding 1% citric acid solution (70°C) with constant stirring till a clean whey is separated at (pH 5.30 to 5.35) and coagulum is allowed to settle for 5 min and drained off the whey. The curd so obtained is filled into hoops lined with muslin or cheese cloth. Pressure is applied on top of the hoop at a rate of 0.5 to 1 kg/cm². The pressed blocks of paneer are removed from the hoops and immersed in pasteurized chilled water for 2-3 hr. The chilled paneer is then removed from water to drain out. Finally, paneer blocks are wrapped in parchment paper / polyethylene bags and placed in cold room at about 5 to 10°C.

21.4.3 Paneer from cow milk
Cow milk yields an inferior product in terms of body and texture. It is criticized to be too soft, weak and fragile and unsuitable for frying and cooking. Buffalo milk contains considerably higher level of casein and minerals particularly calcium and phosphorous, which tends to produce hard and rubbery body while cow milk produces soft and mellow characteristics. By replacing one third of buffalo milk with cow milk, a good quality paneer can be made. Buffalo milk paneer retains higher fat, protein and ash content and lactose as compared to cow milk paneer. To make paneer exclusively from cow milk, certain modifications in the conventional procedure have to be made. Addition of calcium chloride at the rate of 0.08 to 0.1% to milk helps in getting a compact, sliceable, firm and cohesive body and closely knit texture. A higher temperature of coagulation (85°-90°C) with coagulation of milk at pH 5.20 to 5.25 helps in producing good quality paneer from cow milk. However, at this pH of coagulation, moisture, yield and solids recovery are less.

****** ☺ ******

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Lesson 22

RECENT DEVELOPMENTS IN PANEER MANUFACTURING, YIELD, COMPOSITION, FACTORS AFFECTING QUALITY, PACKAGING AND SHELF LIFE

22.1 Use of Ultra filtration in Paneer manufacturing

Ultrafiltration (UF) in paneer making offers the advantages like adaptation to mechanization, uniform quality, improved shelflife, increased yield and nutritionally superior product. In this process milk after standardization and heating is passed through UF membrane where lactose, water and some minerals are removed as permeate. The concentrated mass which has about 40% total solids is cold acidified to get the desired pH. Upto this point the product is flowable and can be easily dispersed into containers with automatic dispersing machines. The filled containers can then be subjected to texturization by passing through microwave tunnels. The resulting product has typical characteristics of normal paneer. The yields increase by about 25% which is due to the retention of good quality whey proteins and slight increase in moisture content (moisture about 70%) yield is about 25%.

22.2 In-package long life paneer like product

A fully mechanized process was developed which yields a long shelf life paneer like product. In this process, standardized buffalo milk is concentrated partly by vacuum concentration and partly by UF to a T.S. content of 30%. Acidified using GDL – Glucono Delta Lactone. After packaging in metallized polyester pouches, the product is formed by texturizing process at 115°C for 5 min which permits concomitant sterilization. The yield of paneer is more due to retention of whey solids and the shelf life is 110, 80 & 47 days at 25, 35 and 45°C respectively.

22.3 Continuous manufacture of paneer

A continuous paneer-making system was developed at NDRI, Karnal by Agarwala (Fig. 22.1). In this system, the unit operations involved in paneer making have been mechanized. The continuous paneer making machine is designed to manufacture 80 kg paneer per hour by employing twin-flanged apron conveyor cum filtering system for obtaining the desired moisture content and texture attributes.
22.1 Schematic diagram of continuous paneer manufacturing unit


The milk heating unit consists of a plate heat exchanger with provision of heat regeneration, heating of milk from 25°C to 90±2°C holding for two minutes and cooling to 70±2°C. Other accessories in this unit are balance tank, pump, flow meter, temperature indicator and auto thermal control unit, etc.

The continuous dewatering and matting unit consists of twin apron conveyer to carry out primary and secondary filtration in the same machine. The lower conveyor is flanged type while the upper one is unflanged type. The flanged unit has perforations for drainage. The additional fine filter of appropriate size is placed over the conveyor to prevent the solids loss. The linear speed of the conveyor is designed to provide optimum residence time required for adequate dewatering. Flexibility in the motion is incorporated through a variable speed drive, giving 5-8 min of residence time. Increasing the width of conveyor can increase capacity of this unit.

22.4 Frozen paneer

This is most commonly adopted method in dairy industry. Paneer slabs are cut into small cubes of about 1cm$^3$ or 1.5 cm$^3$ and then cubes are kept in deep freezer or pass through freezing tunnel to freeze them to -18°C or below. These frozen cubes are packed in a metalized laminates and vacuum packed. Advantages of this method are;

- Less time consumption while thawing
- After thawing one can directly use for preparation of various dishes
- Quickly freeze to -18°C or below
22.5 Yield

The yield of paneer is dependent on the fat and solid not fat (SNF) content of raw milk, as well as the moisture, fat and protein retained in the paneer. Co precipitation of casein and whey proteins is the simplest way of recovering whey proteins and thus increasing the yield of paneer. Heat treatment of milk to 90°C is necessary to achieve good yield. Generally a yield of 20-22 kg is obtained from buffalo milk and 16-18 kg from cow milk.

22.6 Factors affecting quality and yield of paneer

22.6.1 Type of milk

Paneer prepared from buffalo milk possess desirable frying properties, body and texture as compared to cow milk. The cow milk paneer is soft, weak and fragile and during cooking it tends to disintegrate. However, cow milk and buffalo milk mixed in equal quantity yields better product than cow milk. Paneer made from skim milk has chewy and rubbery texture and hard body.

22.6.2 Quality of milk

Milk must be fresh and free from off flavour. Growth of psycrotrophic organisms should be minimized to restrict the off-flavour development. Acidic milk having a titratable acidity of more than 0.20% lactic acid yields a product of inferior quality. Milk with COB positive and low acidity (sweet curdling) is not suitable for paneermaking. Paneer made from such milk has weak body and texture, more moisture, acidic smell and not safe for human consumption.

22.6.3 Type, Strength and Temperature of Coagulant

Product yield and moisture retention are directly influenced by the type and concentration of the acid and the mode of delivery and blending into the hot milk. Citric acid is generally used as a coagulant. Lemon or lime juice or vinegar imparts a typical flavour to the product. 1% solution of citric acid yields good quality of paneer. Sufficient acid is added gently but quickly blended with the milk (within one min) to reach optimum pH of coagulation. Normally 1.8 to 2.0 kg citric acid is required for coagulating 1000lit of milk. High acid concentration imparts acidic flavour, hardness and causes greater solids loss. Whey cultured with Lactobacillusacidophilus at a level of 2% and incubated overnight at 37°C can be used as a substitute for citric acid. However acidic whey must be heat treated to destroy these lactic organisms before use to prevent loss of shelf life of paneer. Coagulation temperature influences the moisture content of paneer. It is reported that an increase in temperature from 60°C to 86°C decreases the moisture content from 59 to 49%. However, optimum coagulation temperature for best organoleptic and frying quality product is 76°C.

22.6.4 Heat treatment of milk

This is one of the technological requirements of the process which affects the sensory and microbiological quality of paneer. The objective of heating milk is to prepare it for rapid iso-electric precipitation, control the moisture content, develop typical body and texture, create conditions conducive to the destruction of pathogenic and other microflora present in milk and ensure safety as well as keeping quality of the final product. The milk is heated to 90°C without holding or 82°C for 5min in order to maximize the total solids recovery. Whey proteins especially β-lactoglobulin and α-lactalbumin form a complex with K-casein and retained with the curd thus increasing the yield of the product. The high heat treatment imparts desirable cooked flavour by controlled liberation of sulphydryl compounds.
22.6.5 Coagulation Temperature

It influences the moisture content of paneer. An increase in temperature from 60°C to 86°C decreases the moisture in paneer from 59 to 49%. At 70°C, paneer made from buffalo milk has the best organoleptic and frying quality in terms of shape retention, softness and integrity.

22.6.6 pH of coagulation

The optimum pH of coagulation of milk at 70°C is 5.30-5.35 for better product quality and maximum recovery of solids when made from buffalo milk. The moisture retention in paneer decreases with the reduction in pH and consequently the yield also decreases. At pH more than 5.35 the paneer is very soft with fragile and crumbly body. Optimum pH for paneer preparation from cow milk is 5.2.

22.7 Composition

Following table depicts the proximal chemical composition of paneer.

Table 22.1: Composition of paneer

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>23.41(50.84 on dry matter basis)</td>
</tr>
<tr>
<td>Protein</td>
<td>18.23</td>
</tr>
<tr>
<td>Lactose</td>
<td>2.40</td>
</tr>
<tr>
<td>Ash</td>
<td>1.90</td>
</tr>
<tr>
<td>Total solids</td>
<td>46.04</td>
</tr>
</tbody>
</table>

22.4 Packaging and shelf life

Polyethylene pouches, cryovac films, co-extruded laminates and retort pouches, are being used for paneer packing. Vacuum packaging of paneer in laminated pouches increases the shelf life to about 30 days at 6°C. Paneer packaged in laminate (EVA/EVA/PVDC/EVA) under vacuum and heat treated at 90°C for one minute increases the shelf life upto 90 days under refrigeration. Paneer packed in tins along with water/brine and sterilized in an autoclave at 15 PSI for 15min lasts for 4 months. The product can be stored under frozen conditions (below -18°C) for more than one year without any deterioration in its quality and used after careful thawing. Paneer dipped in 5% brine solution lasts for about 22 days at 8-10°C. The salting at the time of dipping into chilled water can be used in extending the shelf life of paneer. Dipping in benzoic acid (1200 ppm) increases the shelf life of paneer to 40 days at refrigerated temperature and 20 days at 37°C. By adding sorbic acid to milk (0.15%) and subsequent wrapping of paneer in sorbic acid coated waxed paper, the shelf life of paneer can be increased to 36 days at room temperature.

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Lesson 23

DAHI PREPARATION METHODS, QUALITY OF DAHI, PACKAGING, SHELF LIFE AND DEFECTS

23.1 Introduction

Fermentation is one of the simplest ways of preserving milk constituents for human consumption. Fermentation gives an acid taste to milk which is particularly refreshing in warm climate and also imparts certain therapeutic benefits originally absent in milk. Fermented dairy products have assumed prominent position in human diet in many regions of the world. Fermentation leads to partial breakdown of milk constituents and increases the digestibility of cultured milk products.

In Vedic literature also, we could find many references about fermented milk products some are listed below.

- **Prasadjya** – Dahi after dilution and churning, carrying butter grains in the liquid mass
- **Payasya** – Strained curd, when mixed with boiled milk, crystal sugar and fermented herbs
- **Shrikarini** – Consists of strained dahi, crystal sugar and spices
- **Rasala** -- Sugar and spiced curd

Some of the popular Indian fermented milk products are Dahi, Lassi, Chakka, Shrikhand, Mishti Dahi and Raita.

23.2 Product Description

Dahi is produced from heat treated milks after inoculation with certain species of lactic acid bacteria added to milk in the form of starter culture. Lactic acid bacteria added multiply, grow and produce lactic acid, acetic acid and carbon dioxide by utilizing lactose present in milk. Some bacteria uses citric acid of milk to produce certain volatile organic compounds mainly **diacetyl**, which is mainly responsible for flavor of dahi. Judicious combination of acid producing and flavour producing microorganisms in the starter helps in the production of Dahi with a firm body and good flavour.

23.2.1 Definition of Dahi

Dahi or curd is a semi solid product, obtained from pasteurized or boiled milk by souring, using harmless lactic acid or other bacterial cultures. Dahi may contain additional cane sugar. It should have the same minimum percentage of fat and solids-not-fat as the milk from which it is prepared. Where Dahi or curd, other than skimmed milk Dahi, is sold or offered for sale without any indication of the class of milk, the standards prescribed for Dahi prepared from buffalo milk shall apply.

**Table 23.1 Chemical Composition of Dahi**

<table>
<thead>
<tr>
<th>Components</th>
<th>Whole milk Dahi (%)</th>
<th>Skim milk Dahi (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>85-88</td>
<td>90-91</td>
</tr>
<tr>
<td>Fat</td>
<td>5 – 8</td>
<td>0.05 - 0.1</td>
</tr>
<tr>
<td>protein</td>
<td>3.2-3.4</td>
<td>3.3-3.5</td>
</tr>
<tr>
<td>Lactose</td>
<td>4.6-5.2</td>
<td>4.7-5.3</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>0.5-1.1</td>
<td>0.5-1.1</td>
</tr>
<tr>
<td>Ash</td>
<td>0.7-0.75</td>
<td>0.7-0.75</td>
</tr>
</tbody>
</table>
Table 23.2 FSSR(2011) and BIS standards of Dahi

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>FSSR(2011)</th>
<th>BIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity % lactic acid</td>
<td>-</td>
<td>0.6 - 0.8</td>
</tr>
<tr>
<td>Total Plate count</td>
<td>Not more than 1000000/g</td>
<td></td>
</tr>
<tr>
<td>Coliform count</td>
<td>10 per g max</td>
<td>10 per g max</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>Absent in 1g</td>
<td></td>
</tr>
<tr>
<td>Salmonella</td>
<td>Absent in 25g</td>
<td></td>
</tr>
<tr>
<td>Shigella</td>
<td>Absent in 25g</td>
<td></td>
</tr>
<tr>
<td><em>Stephyllococcus aurius</em></td>
<td>Not more than 100/g</td>
<td></td>
</tr>
<tr>
<td>Yeast and Mould</td>
<td>100 per g max</td>
<td>100 per g max</td>
</tr>
<tr>
<td>Anaerobic spore</td>
<td>Absent in 1g</td>
<td></td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>Absent in 1g</td>
<td></td>
</tr>
<tr>
<td>Phosphatase test</td>
<td>It should have the same minimum percentage of fat and SNF as the milk from which it is prepared. If no standards declared then standards prescribed for dahi from buffalo milk shall apply</td>
<td>Negative</td>
</tr>
</tbody>
</table>

 Other requirements

Dahi shall conform to the requirements of milk fat and MSNF, as laid down in FSSR, 2011

23.3 Method of Preparation

23.3.1 Traditional method

In traditional method of dahi preparation, milk is heated intensively to boil for 5 to 10 min and then it is cooled to room temperature. cooled milk is added with previous day’s curd or buttermilk, stirred and allowed to set undisturbed usually for overnight.

At halwai’s shop milk is considerably concentrated before being inoculated with starter culture. So that the total solid content of milk gets increased, particularly increase in the protein content of milk. Concentration of milk results in custard like consistency of dahi and keeps the product from wheying off.

23.3.2 Industrial method of making dahi

23.3.2.1 Selection of raw material

Production of cultured/fermented milk demands high quality raw materials with respect to physical, chemical and microbial standards.

23.3.2.2 Filtration/clarification

Fresh raw milk is heated to 35 to 40°C to aid clarification or filtration process then it is filtered to ensure that, milk is free from extraneous matter.

23.3.2.3 Standardization: Fat: 0 – 5%, SNF: 11 – 13%

Fat is standardized based on type of product ranging from fat free to full fat and SNF level is increased by min. 2% than that of milk. It is common to boost the SNF content of the milk to about 12% with the addition of skim milk powder or condensed skim milk.

Increased SNF intern increases the protein, calcium and other nutrients and resulted with improved body and texture, custard like consistency. Higher milk solids prevent wheying off of the product during storage.
23.3.2.4 Homogenization: 175 Kg/cm²

The standardized milk is subjected to homogenization after heating to 60°C to increase the efficiency. Homogenization reduces the cream layer formation during incubation. Single stage homogenization with 175 kg/cm² pressure would be sufficient to improve texture of dahi.

23.3.2.5 Heat treatment: 95°C/23min

Milk intended for dahi or any other fermented milk product is given severe heat treatment i.e. 90°C for 10min. Following are the benefits of high heat treatment:

- Denatures and coagulates milk albumin and globulins which enhance the viscosity and produce custard like consistency
- Kills contaminating and competitive microbes
- Development of relatively sterile medium
- Removal of air from the medium – more conducive for the growth of culture bacteria
- Effective thermal breakdown of protein releasing peptones and sulfhydryl groups, this in turn provide nutrients to starter bacteria

23.3.2.6 Packaging and fermentation

The heat treated product mix is cooled to 37°C and it is inoculated with specific dahi culture at the rate of 1 to 1.5%. Starter culture is the most crucial component in the production of high quality fermented milks. Proper selection of culture strains decides the good quality of product. Dairy cultures are available in various forms like freeze dried, liquid and frozen forms. After the product mix is inoculated with dahi culture it is thoroughly mixed and filled into plastic cups, sealed properly to avoid any contamination and spillage of the product. Dahi is packed in food grade polystyrene and polypropylene cups in 100g, 200g and 400g pack sizes. Various
packaging machines of up to 400 cups/min speed are available to package cultural dairy products in different sizes. The packaged product should be stored at < 5°C for extended shelf life. Thus packed product is arranged in cases or crates and transferred to incubation room maintained at 37°C to 42°C. The product mix is incubated till its pH reaches 4.4 to 4.5 and then it is cooled rapidly to less than 5°C by exposing the cups to high velocity cold air.

23.3.2.7 Storage

Dahi is normally stored at 4 – 5°C. Storage area should be maintained clean and tidy to avoid any cross contamination.

**Table 23.3 Common defects in dahi**

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Defect</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flavor defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Insufficient Flavor</td>
<td>Low citrate level in milk, Low diacetyl content</td>
<td>Add 0.02 – 0.05% Sodium citrate prior to mixing the starter culture. Cool rapidly after culturing</td>
</tr>
<tr>
<td>2</td>
<td>Oxidized flavor</td>
<td>Copper contamination Exposure to fluorescent light Exposure to sunlight</td>
<td>Avoid usage of copper utensils Protect product from direct exposure to sunlight/ UV light</td>
</tr>
<tr>
<td>3</td>
<td>Yeast/cheesy</td>
<td>Contaminating yeast growth</td>
<td>Sanitation check</td>
</tr>
<tr>
<td>4</td>
<td>Rancid flavor</td>
<td>Lipolytic activity</td>
<td>Do not mix pasteurized and raw dairy ingredients prior to homogenization</td>
</tr>
<tr>
<td>5</td>
<td>High acid</td>
<td>Addition of more culture, Increased incubation time Use of sour milk</td>
<td>Optimum culture addition Blast cool the product immediately after optimum pH is reached Use good quality fresh milk</td>
</tr>
<tr>
<td></td>
<td>Body and textural defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Weak body</td>
<td>Insufficient heat treatment to the mix Too low milk SNF Severe agitation after fermentation</td>
<td>Heat treatment should not be less than 85°C/30min Homogenize the dahi mix prior to homogenization Increase the MSNF content to 11% by adding Skim milk powder</td>
</tr>
<tr>
<td>2</td>
<td>Grainy texture</td>
<td>High acidity Improper dispersion of Skim milk powder</td>
<td>Rapidly cool the product to &lt;5°C after attaining optimum acidity Use in line screen/filter</td>
</tr>
<tr>
<td>3</td>
<td>Syneresis</td>
<td>Insufficient heat treatment to the mix Improper standardization and too low milk SNF Agitation/disturbances during fermentation</td>
<td>Heat treatment should not be less than 85°C/30min Increase the MSNF content to min. of 11% by adding Skim milk powder Do not disturb the cups during fermentation</td>
</tr>
<tr>
<td>4</td>
<td>Ropiness</td>
<td>Contamination of milk with psychotropic microorganisms Culture contamination/impure culture</td>
<td>Proper heat treatment of milk, Avoid cold storage of milk before pasteurization/thermization Use of pure culture</td>
</tr>
</tbody>
</table>
Lesson 24
MISTI DAHI PREPARATION, QUALITY, PACKAGING AND SHELF LIFE, DEFECTS

24.1 Introduction
Misti dahi is also known as Misti doi, Payodhi and Lal dahi. It is a traditional sweetened fermented milk product popular in the eastern part of India, notably West Bengal, Bihar and Assam. It is prepared by lactic acid fermentation of sweetened milk. Misti dahi is regarded as a special dessert on ceremonial occasions both in the rural and urban Bengal. The product is commonly available in earthen pots of different sizes. A good misti dahi has a characteristic brown colour, firm consistency, smooth texture and caramelized flavour.

Buffalo milk is preferred for the preparation of Misti dahi due to high fat content, which induce a rich creamy product with excellent mouth feel. The high protein content of buffalo milk leads to the formation of firm coagulum which resists whey separation during storage and transportation.

24.2 Traditional method of Misti dahi preparation
Traditionally, it is prepared by Halwais on a small scale to meet the local demand. Whole cow milk or buffalo milk or their combination is added with sugar (upto15% of the milk) and it is heated continuously in an open pan at a simmering temperature of 68-70°C for 6-7 hours or boiled to reduce the volume to 60-70% of the original. Intense heating imparts cooked flavour and brownish colour to the product. Artificial colour, caramel sugar and/or jaggery are also added based on the consumer preference. The mix is then cooled to about 40°C and inoculated with the previous day’s product. It is then filled into earthen pots of consumer size or bulk size vessels and incubated overnight at room temperature. After firm setting of curd, it is shifted to a cooler place or stored under refrigeration temperature.

The conditions, under which the product is generally prepared, stored and marketed by the halwais are unhygienic. The product is sometimes contaminated with different types of microorganisms including yeasts and moulds which gain entry into the product from utensils and surroundings. Many flavour defects such as fruity, alcohol, highly acidic and flat and textural defects such as gassiness, weak body, wheying off and thick crust on top surface are observed in most of the market samples. These defects may be due to difference in quality of milk, degree of concentration of milk solids, type of culture used, incubation time, processing conditions and temperature of storage.

In view of the growing demand, a technology for industrial production of this product has been standardized.

24.3 Industrial method of production
In the organized sector a wide range of milk products are used for sourcing milk solids for the production of misti dahi. Extreme care is needed in the selection and use of the raw materials and sweeteners. The ingredients should be fresh, good in microbial and sensory quality.

Calculated amount of milk and cream is taken into a multipurpose vat. Skim milk powder is added through a venturi assembly to increase the level of total solids and sugar is added at the rate of 9 – 10%. Commercially available Caramel is added normally at the rate of 0.10 to 0.12%. After the mix is prepared, it is heated to 90°C for 10 min in a vat or plate pasteurizer. Then the product is cooled to 40 – 42°C and starter culture containing Lactococcus lactis subsp. lactis and Lactococcus lactis var. diacetilactis is added at the rate of 1% to the mix and mixed well. Selection of appropriate type of starter culture is very important and crucial as it affects the flavour, consistency and acidity development in the presence of sugar and caramel. After inoculation the product is packed into sanitized polystyrene cups and sealed airtight. The sealed cups are incubated at 40 – 42°C for about 6 to 8 hours till the acidity develops to about 0.8 % lactic acid.
Once the product develops the desired acidity level of 0.8% lactic acid, it is shifted from incubation room to cold store and maintained at < 5°C. Care should be taken to maintain the temperature of the cold store, so that product doesn’t freeze.

![Flow diagram for production of Misti dahi](image)

Sugar controls the acid production of *misti dahi* because of its effects on osmotic pressure and improves its acceptability. Sugar helps in carmalization and development of brown color which is desirable, product should be stored at 5°C or below. Higher temperature of storage can lead to defects like whey separation and bitterness. Very low temperature induces ice-crystals formation which damages the texture.

<table>
<thead>
<tr>
<th>Chemical composition of misti dahi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constituent</strong></td>
</tr>
<tr>
<td>Milk Fat</td>
</tr>
<tr>
<td>Milk SNF</td>
</tr>
<tr>
<td>Sucrose</td>
</tr>
<tr>
<td>Total solids</td>
</tr>
</tbody>
</table>

### 24.5 Shelf Life
Due of high acidity (0.8%) and high sugar level *misti dahi* has a shelf life of about 12 days at 4°C and 2 days at 30°C. The shelf life mainly depends on post manufacture contamination particularly with yeast and moulds. Hence attempt should be made not to unduly expose the finished product to atmospheric contamination.

### 24.6 Packaging
*Misti dahi* is packed in food grade polystyrene and polypropylene cups in 100g, 200g pack sizes. Various packaging machines of upto 400 cups/min speed are available to package cultured dairy products in different...
sizes. The packaged product should be stored at <5°C for extended shelf life.

16.7 Factors affecting the quality Misti dahi
24.7.1 Level of fat
With the increase in the fat percentage there is a decrease in acid development and increase in flavour volatile due to stimulation of the culture to produce more flavour volatiles specially acetoin. Misti dahi prepared with low fat content produces a firm curd with higher curd tension.

24.7.2 Homogenization pressure
The flavour volatiles increase with the increase in homogenization pressure due to availability of substrate material, consequent to homogenization which may stimulate the flavour production activity of starter culture. In unhomogenised misti dahi, there is fat separation and the product lacks in smooth creamy taste.

24.7.3 Level of milk solids not fat (MSNF)
The average initial acidity of milk increases with the increase in MSNF content and the rate of acid development lowers with increase in MSNF content. The increased osmotic pressure (Due to increase in soluble constituents e.g. lactose and salts from higher level of MSNF) in milk slows down the acid development by the culture bacteria. There is reduction in amount of flavour volatiles due to high MSNF which is dependent on pH. The firmness of misti dahi increases with the increase in MSNF content. The increased concentration of casein improves the water binding capacity the curd.

24.7.4 Level of cane sugar
At higher sugar levels there is a reduction in water activity which inhibits the growth of starter bacteria. Thus diminishing acid and flavour production. The production of diacetyl and acetyl methyl carbinol decreases with increase in sugar level. The curd tension of misti dahi is lowered with the increase in sugar level. The higher sugar concentration leading to lower acid development and correspondingly with higher pH will prevents formation of a firm gel.

24.7.5 Defects in Misti dahi
Fruity flavor, alcoholic, acidic and flat flavor are the common flavor defects normally found in market samples of Misti dahi. Common textural defects include gassiness, weak body, whey off and soggy body. By following standard manufacturing protocol and maintaining chemical standard these defects could be controlled.
Lesson 25
CHAKKA- PRODUCT DESCRIPTION, METHODS OF MANUFACTURE

25.1 Product Description
Chakka is a fermented, intermediate dairy product obtained during the production of Shrikhand. Chakka can be described as strained dahi, in other words it is the curd mass obtained after removing whey from dahi, either through muslin cloth or basket centrifuge. Chakka is the base material for the production of shrikhand and shrikhand wadi.

25.2 Traditional method of making chakka
In traditional method, cow or buffalo or mixed milk is boiled thoroughly and cooled to room temperature (30°C). Previous day curd is added to this milk at the rate of 1 to 1.5 %. Milk is left undisturbed overnight at room temperature to set firmly. It is then stirred and hung in a muslin cloth for 10 to 12 hrs to drain off whey. The curd mass obtained after removal of whey is called as chakka.

![Flow diagram for traditional method of making chakka](image)

25.3 Industrial Production of Chakka
Skim milk is normally used in the commercial production of chakka. Low fat in the curd resulted with significant reduction in fat loss through whey, faster moisture expulsion and lower moisture retention in the final product.

Fresh, good quality skim milk is received and heated to 90°C for 10min. High heat treatment kills the competitive microbes and create congenial environment for the growth of culture bacteria. Heat treated milk is cooled to 30°C and inoculated with LF-40 culture containing Lactococcus lactis subsp. lactis and Lactococcus Lactis var. diacetylactis at the rate of 1.0 – 1.5%. Milk added with culture bacteria is incubated at 30°C for 10-12hr. After the required acidity of 0.8 to 0.9% LA is reached, the curd is taken into basket centrifuge or quarg separator to remove whey from the curd. Use of quarg separator for removal of whey has increased the chakka production to 8 tonnes/day. Thus obtained curd mass/chakka is ready for further processing to the production of shrikhand.
Table 25.1 Chemical composition of Chakka

<table>
<thead>
<tr>
<th>Constituent</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>71-72</td>
</tr>
<tr>
<td>Fat</td>
<td>11.5</td>
</tr>
<tr>
<td>Proteins</td>
<td>12.5</td>
</tr>
<tr>
<td>Lactose (dry matter basis)</td>
<td>2.5-3.5</td>
</tr>
<tr>
<td>Total ash</td>
<td>1.0</td>
</tr>
<tr>
<td>Titratable acidity (% LA max.)</td>
<td>2.1</td>
</tr>
</tbody>
</table>

25.4 Yield of Chakka

The yield of chakka produced traditionally is about 650g per 1000g of milk and yield of shrikhand is about 1.5 to 2.0kg per kg of chakka. Yield of Chakka is about 20% more and shrikhand is 38.5% more than that of traditional method, when produced commercially.

Table 25.2 FSSR (2011) and BIS requirement for chakka

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Components</th>
<th>FSSR (2011)</th>
<th>BIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Skim milk Chakka</td>
<td>Whole milk Chakka</td>
</tr>
<tr>
<td>1</td>
<td>Total Solids (% Min) on DM</td>
<td>20.0</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Milk Fat % on DM</td>
<td>5.0 (Max)</td>
<td>33.0 (Min)</td>
</tr>
<tr>
<td>3</td>
<td>Milk Protein % (Min) on DM</td>
<td>60.0</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Titratable Acidity (% LA Max)</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>Total ash on DM (% Max)</td>
<td>5.0</td>
<td>3.5</td>
</tr>
<tr>
<td>6</td>
<td>Total plate count/g</td>
<td>Max 50,000</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Coliform/g Max</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Yeast and Mould/g (Max)</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>
Lesson 26
SHRIKHAND- METHODS OF PRODUCTION, PACKAGING AND PRESERVATION

26.1 Shrikhand
26.1.1 Product description
Shrikhand is a popular fermented, sweetened, indigenous dairy product having semi solid consistency with typical sweetish-sour taste. It is very popular in the state of Gujarat, Maharashtra and part of Karnataka. It is prepared by mixing chakka with sugar, color, flavor, spices and other ingredients like fruit pulp, nuts etc. to form soft homogenous mass.

<table>
<thead>
<tr>
<th>Total solids (percent, by mass min.)</th>
<th>BIS</th>
<th>FSSR (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk fat (% on dry matter, min.)</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Milk protein (% on dry matter, min.)</td>
<td>10.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Titratable acidity (max.)</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Sucrose (% on dry matter, max.)</td>
<td>72.5</td>
<td>72.5</td>
</tr>
<tr>
<td>Total ash (% on dry matter, max.)</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Coliform count (cfu/gm, max.)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Yeast and mould (cfu/gm, max.)</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

PFA: In fruit Shrikhand milk fat on dry matter basis not less than 7.0% and protein on dry matter not less than 9.0%.

26.2 Traditional method of making shrikhand
Traditionally shrikhand is prepared by boiling cow or buffalo or mixed milk and cooled to room temperature (30°C). Heated and cooled milk is added with previous day dahi at the rate of 0.5 to 1 %. Milk is left undisturbed overnight at room temperature to set firmly. It is then stirred and hung in a muslin cloth for 10 to 12 hr to drain off whey. The curd mass obtained after removal of whey is called as chakka. Chakka is then added with calculated amount of sugar, color, flavour and other optional ingredients like fruits, nuts, spices, herbs and served chilled.

The chakka obtained from whole milk/ standardized milk has smooth body, whereas the one obtained from skim milk is little rough and dry. When whole milk is used for chakka making, high fat loss occurs in whey thereby affecting the recovery of fat in chakka. Therefore, it is preferred to use skim milk for chakka making and then mixing of cream or unsalted butter to adjust the fat in the finished product. Homogenization of milk leads to slow drainage of whey giving higher moisture content in chakka and a product with very soft consistency (not liked by the consumers). Conventionally made chakka varies from batch to batch with regard to moisture and acidity. Moisture content affects the yield, consistency and composition, whereas acidity affects the taste and quantity of sugar to be added.

26.3 Industrial production of Shrikhand
With a view to overcome some of the limitations of the traditional method and to partially mechanize the shrikhand production, a semi-mechanized large scale production is employed. Shrikhand is the first traditional milk product for which large scale production technology was adopted. The first modern plant has been established at the Baroda District Cooperative Milk Producers Union Ltd. Baroda Dairy has adopted a process...
which involves use of basket centrifuge for speedy draining of whey and a planetary mixer for kneading and mixing of ingredients.

For industrial production of shrikhand, fresh skim milk is used as a raw material.

Use of skim milk has got many advantages as listed below:
- Fat losses are eliminated
- Faster moisture expulsion
- Less moisture retention

Skim milk is heated to 85°C for 30 min, cooled to 30°C and inoculated with LF-40 culture containing *Lactococcus lactis* subsp. *lactis* and *Lactococcus Lactis* var. *diacetilactis* at the rate of 1.0 – 1.5%. After the required acidity of 0.8 to 1.0 is reached, the curd is taken into basket centrifuge or quarg separator to remove whey from the curd. The curd mass or chakka is taken into planetary mixer or scraped surface heat exchanger. Sugar at the rate of 80% w/w, calculated amount of plastic cream (80% fat) to give at least 8.5% FDM in the finished product are added and mixed thoroughly. Optimal ingredients like color, flavor, fruits, nuts etc. can also be added at this stage. Then it is packed at room temperature and stored at refrigeration temperature.

<table>
<thead>
<tr>
<th>Tabel 26.2 Chemical composition of shrikhand</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>35-40</td>
</tr>
<tr>
<td>Fat (dry matter basis)</td>
<td>8.5-9.0</td>
</tr>
<tr>
<td>Proteins (dry matter basis)</td>
<td>9.5-12.5</td>
</tr>
<tr>
<td>Lactose (dry matter basis)</td>
<td>2.5-3.5</td>
</tr>
<tr>
<td>Sucrose (dry matter basis)</td>
<td>70-74</td>
</tr>
<tr>
<td>Total ash (dry matter basis)</td>
<td>0.6-0.5</td>
</tr>
<tr>
<td>Titratable acidity (max.)</td>
<td>1.0-1.30</td>
</tr>
<tr>
<td>pH</td>
<td>4.3-4.1</td>
</tr>
</tbody>
</table>

26.4 Packaging of shrikhand
As shrikhand is a semi solid product, heat sealable polystyrene cups of 100g to 1000g capacity are commonly used for packing shrikhand. However, small manufacturer sell the product in wax coated paper board boxes.

26.5 Shelf life of Shrikhand
Due to both high acid and sugar levels, shrikhand has a fairly long shelf-life of 30-40 days at 8°C and 2-3 days at 30°C. The shelf-life depends largely on the initial level of contaminating organisms particularly yeast and moulds. The shelf life of shrikhand can be increased by addition of potassium sorbate 0.05% or by thermization at 65°C for 10 min coupled with addition of 0.02% sorbic acid. For industrial purposes pasteurization of shrikhand at 65°C/10min and subsequent freezing can increase the shelf life upto 12 months at -26°C.
26.6 Innovations

- Use of basket centrifuge or quarg separator for the production of Chakka - use of basket centrifuge increased the curd production to 80kg/hr. The quarg separator has got the capacity to produce 2,500kg of curd per hour. This permits to scale up the production up to 8tonnes/day and minimizes the batch to batch variation with respect to moisture content and thereby quality of the product.

- Use of planetary mixer or Scraped surface heat exchanger for mixing chakka with sugar and other optional ingredients. These processes not only produce homogenous mixture but also increase the production capacity up to 40 to 500kg per batch.

- Starter culture – different combination of lactic strains have been developed to produce superior quality of shrikhand e.g. *Lactococcus lactis, Lactococcus lactis var. diacetylactis*, and *Leuconostoc cremoris* in the ratio of 1:1:1, *Streptococcus thermophilus*and *Lactobacillus bulgaricus* in the ratio of 1:1. The LF-40 culture containing *Lactococcus lactis* subsp. lactis + *Lactococcus Lactis*Var. diacetylactis has received wide acceptance by many shrikhand manufacturers.

- Manufacture of shrikhand using UF-chakka
- Manufacture of fruit flavored shrikhand
- Manufacture of shrikhand using low calorie sweeteners.
Lesson 27
LASSI AND CHHACHH/MATTHA (COUNTRY BUTTERMILK) - METHODS OF MANUFACTURE, PACKAGING AND SHELF LIFE, DEFECTS

27.1 Introduction
Butter milk is a popular refreshing drink prepared from the by-product produced during the preparation of butter/makkhan from dahi. Butter milk is also known as Mattha, Chhachh or Chhas in northern part of India. In south India it is called as Majjige or Majjika. The sweet variety of the product is relished in the northern part of the country, whereas the sour variety is preferred in the south.

27.1.1 Product description
Butter milk is similar to skim milk in composition except acidity of the product. It is generated during the production of butter from dahi by desi method. To this butter milk salt, coriander, ginger, onion are added to improve palatability. It is popular because of its aroma, mildly acidic taste developed during fermentation by mixed strains of lactic acid bacteria. In southern part of the country butter milk is prepared by churning high acid curd and addition of water to reduce acidity. Butter milk is consumed directly or along with rice and pickle.

27.1.2 Method of manufacture
Milk is boiled and then cooled to 30° – 35°C. It is added with dahi culture or previous day’s dahi at the rate of 1.0 to 1.5%. Milk is allowed to set overnight. Set curd is stirred using a mathani (wooden/steel stirrer with impellers) driven by a small rope in to-and-fro circular motion. During this action, small grains of butter are formed and raised to top of the vessel and it is scooped out from time to time. When all the butter is recovered, the residual watery fluid is referred as butter milk/chhach/mattha/chhas. This can be consumed directly or sweetened or salted and added with spices based on the preference.

![Flow Diagram for the manufacture of Butter Milk](image-url)
27.1.3 Chemical and nutritional quality
Butter milk is lower in fat than regular milk, because the fat has been removed to make butter. It is high in potassium, vitamin B12, calcium, and riboflavin as well as a good source of phosphorus. It contains higher amounts of phospholipids. According to Ayurveda it reduces bloating of stomach, and helps in curing indigestion. Butter milk detoxifies body and cleanses the intestines, relieves constipation and helps to replenish intestinal flora.

27.2 Lassi
Lassi, similar to butter milk, is a refreshing summer beverage popular in north India. Lassi is a white to creamy white viscous liquid with a sweetish, rich aroma and mild to high acidic taste. It is flavored either with salt or sugar and other condiments, depending on regional preferences.

27.2.1 Product description
Lassi can be described as a fermented milk beverage obtained after the growth of selected lactic acid bacteria in heat treated milk followed by sweetening with sugar. It is consumed as a cold refreshing beverage in summer. It is prepared by breaking the curd in to fine particles by agitation, addition of sugar, water and optionally flavor.

Table 27.1 Chemical composition of Lassi

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Components</th>
<th>% in the Lassi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Milk Fat</td>
<td>1.5 – 3.8</td>
</tr>
<tr>
<td>2</td>
<td>Milk SNF</td>
<td>9.00</td>
</tr>
<tr>
<td>3</td>
<td>Sugar</td>
<td>13 – 15</td>
</tr>
<tr>
<td>4</td>
<td>Low Methoxy pectin</td>
<td>0.5</td>
</tr>
<tr>
<td>5</td>
<td>Acidity</td>
<td>0.7% LA min</td>
</tr>
</tbody>
</table>
27.2.2 Industrial production
Lassi is becoming popular and attracting demand throughout the year. To meet the consumer demand many dairies have started producing lassi on commercial scale. Similar to dahi, fresh, good quality milk is essential for production of good quality lassi. Raw milk is standardized for the fat content ranging between 1.5 – 3.8% and 9% SNF. Standardized milk is heated to 90ºC for 15 min, cooled to 60ºC and homogenized at 150kg/cm² and 50kg/cm² at 1st and 2nd stage respectively. Milk is cooled to 30–32ºC, inoculated with lactic culture and incubated to attain the pH of 4.5. The curd is broken with the help of a power driven agitator. Sugar syrup (25% syrup) is added to the mix to give 12% sugar concentration in the blend. Low methoxy pectin after making solution in water/syrup can also be added @ 0.5% at this stage as a stabilizer to improve the appearance and mouth feel. The mixture can be flavored with rose water and homogenized to improve body and texture. It is packed and stored at refrigeration temperature.

27.2.3 Packaging of butter milk and lassi
Butter milk and lassi are normally packed in polyethylene pouch. Form fill seal machines are widely used for high speed packing. Lassi and butter milk are filled in 60 – 80 micron LLDPE (linear low density polyethylene) pillow type pouches of 200 ml at the rate of 5000 pouches per hr. Lassi subjected to UHT processing is packed aseptically in rigid laminates.

27.2.4 Shelf life of butter milk and lassi
Butter milk and lassi packed in LLDPE pouch can be stored up to 7 days at 5ºC without any significant change in its sensory qualities. Lassi subjected to UHT treatment and packed aseptically has shelf life upto 120 days.

The therapeutic value of fermented milk drinks is largely dependent upon the presence of live-active bacteria. UHT processing will destroy the lactic acid bacteria reducing the food value of the sterilized products.
<table>
<thead>
<tr>
<th>Sl No</th>
<th>Defect</th>
<th>Probable Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Flavor defects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Insufficient Flavour</td>
<td>Low citrate level in milk,</td>
<td>Add 0.02 – 0.05% Sodium citrate prior to the mix Cool rapidly after culturing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low diacetyl content</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Oxidized flavor</td>
<td>Copper contamination</td>
<td>Avoid usage of copper utensils Protect product from direct exposure to Sunlight/ UV light</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exposure to fluorescent light</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exposure to sunlight</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Yeast/cheesy</td>
<td>Contaminating yeast growth</td>
<td>Sanitation check</td>
</tr>
<tr>
<td>4</td>
<td>Rancid flavor</td>
<td>Lipolytic activity</td>
<td>Do not mix pasteurized and raw dairy ingredients prior to homogenization</td>
</tr>
<tr>
<td>5</td>
<td>High acid</td>
<td>Addition of more culture,</td>
<td>Optimum culture addition Blast cool the product immediately after optimum pH is reached Use good quality fresh milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased incubation time</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use of sour milk</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Body and Textural defects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Too thick</td>
<td>High MSNF</td>
<td>Proper standardization Addition of calculated amount of stabilizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use of higher amounts of stabilizer</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Too thin</td>
<td>More dilution of dahi</td>
<td>Proper standardization Addition of calculated amount of stabilizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low/no stabilizer</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Whey separation</td>
<td>Low/no stabilizer</td>
<td>Proper standardization of dahi milk Addition of calculated amount of stabilizer Homogenization of lassi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low MSNF</td>
<td></td>
</tr>
</tbody>
</table>
Module 11. Miscellaneous traditional dairy foods

Lesson 28
RAITA, KADHI, DAHIWADA AND RAABADI

28.1 Introduction
Kadhi is a well-known culinary food item prepared from dahi in many parts of India. Ancient Indian medical literature describes a dish termed Kadha, made from sour dahi with the addition of wood apple fruit and Indian sorrel leaves followed by seasoning with pepper and cumin. Variant called kambalika can be prepared by addition of oil, sesame seeds and black gram dal.

The composition of kadhi varies from region to region, depending on consumer preference. Milk solid content in kadhi varies from 6-8 per cent and other solids range from 6-7 per cent. Kadhi exhibits a mildly acidic taste with characteristic cooked flavour.

In the traditional method of kadhi preparation, 5-8 per cent of Bengal gram flour (besan) is added to stirred dahi or buttermilk. Besan acts as a thickening agent. In addition, boiled vegetables and fried balls of spiced Bengal gram batter (pakora) may be added at the end of preparation as filling materials. Salt and grated onion along with spices may also be used to garnish kadhi.

28.1.1 Method of preparation
Kadhi is prepared from dahi made from milk standardized to 0.8-1.0 per cent fat. Milk is pasteurized, cooled to 37°C and inoculated with a mixed culture of L. lactis, S. thermophilus and L. cremoris. This mixture is incubated at 37°C until an acidity of 0.95 per cent (expressed as % lactic acid) is attained. The fermented dahi is stirred vigorously in a mixer or using a stirrer. Bengal gram flour at 5 per cent level of dahi along with equal quantity of water is added to the stirred dahi. Variation in the concentration of Bengal gram flour can change the body and consistency of kadhi. After mixing thoroughly, the mixture is cooked at boiling temperature and held at that temperature for 10-15 min. At this stage, appropriate quantity of turmeric powder, spices and salt are added. At the end of boiling, the total solids content will be approximately 14-16 per cent.

Research was undertaken to standardize a method for the manufacture of dehydrated kadhi or kasha, a ready to mix product to be used for making regular kadhi on reconstitution (Fig. 28.1).

28.2 Kadhi Powder
It is dehydrated kadhi, a convenience product of the future. To produce dried kadhi, the slurry obtained by the process described in 28.1.1 is cooled to about 60°C and dried on a double drum roller dryer. The recommended speed of roller is 16-20 rpm and a steam pressure of 45-50 psi.
28.2.1 Packaging
The dehydrated *kadhi* keeps well for 12 weeks when packed in low-density polyethylene pouches. It is possible to increase its shelf life by packaging it in high-density polyethylene, high molecular, high-density laminated pouches.

28.3 Raita
It is made from *dahi* and served as an additional dish with meals. It is consumed with rice or *roti*. To prepare *raita*, *dahi* is lightly beaten, spiced and salted to taste. Optional ingredients added to this base include boiled and diced potatoes, raw onion pieces, grated raw cucumber, tomatoes, carrots, pumpkin, ginger, grated coconut and roasted cumin seeds or fried mustard seeds. Sometimes pieces of fruit like banana and mango may be incorporated after adding sugar and cardamom. *Raita* containing fried *besan* (gram flour) or Black gram *dal* flour granules is particularly popular. Usually, *raita* is consumed in a freshform.
At times small quantity of milk is added to dahi to develop a soft consistency. It is mixed with salt, black pepper and fried mustard seeds or roasted cumin seeds. The boiled or raw vegetables or besan / moong granules are then added and mixed thoroughly. Fruits may be added at this stage. The mixture is garnished with a little red pepper, garam masala and chopped mint / coriander leaves and allowed to stand undisturbed for a few minutes to equilibrate and develop uniform flavour. Depending on regional preferences the quality and optional ingredients added will vary. For example, the ginger curd of Kerala is a thick ginger-based raita containing pieces of chopped ginger, green chilles and salt.

28.4 Dahiwada
Dahiwada is eaten as a snack or may accompany a meal as a side dish. To prepare this dish, deep fried black gram dal batter patties (wada) are dipped in dahi and allowed to soak. They are usually garnished with sweet chutney prepared from tamarind and jaggery.

28.4.1 Preparation of dahiwada
The ingredients needed are 500 g of black gram dal, small amount of red chilli powder, 500 g of dahi, frying oil, salt, ginger and other spices. The dal is soaked in water overnight. It is then drained and ground to a thick batter, using as little water as possible. It is mixed with spices and shaped into patties of 5-7 cm diameter and 1 cm thickness. Nutritionally rich wadas are prepared by placing nut pieces in the centre before frying.

The patties are fried in ghee or oil at 150°C until they are cooked properly. They are soaked in salt water for 10 minutes and excessive water is squeezed out. This process assists in the absorption of stirred dahi, which is beaten to a thinner consistency after addition of salt and spices. The patties (wada) are soaked in the beaten dahi. The patties should be covered completely with dahi to ensure full absorption of dahi liquor by the patties. Before serving, dahiwada is garnished with, chilli powder and sometimes with chopped mint leaves. A tamarind sauce is prepared separately by using tamarind pulp and jaggery. Dahiwadas are garnished with tamarind sauce before serving.

28.5 Raabadi
Raabadi is a fermented indigenous food of India especially useful for low and average income rural people who have an easy access to buttermilk. It is popular in North-Western semi-arid regions of India and can be prepared by mixing and fermenting flour of wheat, pearl millet, barley or maize with buttermilk in summer months at room temperature (40-45°C) for 4-6 h. The fermented product is boiled, salted to taste, cooled and consumed. It is a lactic acid fermented food in which lactose undergoes acid fermentation naturally and readily (Gupta, 1989). Cereals/millets have potential to be incorporated in probiotic dairy foods formulation because of their richness in fiber, oligosaccharides, free amino acids and certain minerals which promote the growth of probiotic bacteria. Human-derived strains of L. reuteri, L. plantarum, L. acidophilus, and a L. fermentum strain isolated from cereals when cultured in malt, barley, and wheat extracts exhibited better cell growth in malt medium than in barley and wheat extracts due to the higher proportion of maltose, sucrose, glucose, and fructose (Charalampopoulos et al., 2002b; Charalampopoulos and Pandiella, 2010).

Another research work carried out on raabadi preparation using pearl millet at NDRI, Karnal by Modha, H et al., (2011). Skim milk and flour of 24 h germinated pearl millet grains (PMG-24 h) were used as sources of solids. Flour of PMG-24 h was mixed in skim milk before fermentation and level of flour and water were determined using Response Surface Methodology (RSM) with central composite rotatable design (CCRD). The...
product developed using 5.3% flour gave the most acceptable product. For further stabilization during storage, pectin and/or carboxy methyl cellulose were tried at different levels and a level of 0.6% pectin was selected. The standardized product was packaged in glass bottles and stored under refrigeration (5-7 degrees C). The researchers concluded the shelflife of the product as 7 days at refrigerated temperature.
APPLICATION OF MEMBRANE TECHNOLOGY

29.1 Introduction
Membrane technology is a pressure driven filtration process which discriminate the molecules primarily on the basis of size and to a lesser extent on shape and chemical composition. The main membrane systems widely used, in the ascending order of pore size, are reverse osmosis (RO), nano-filtration (NF), ultrafiltration (UF) and microfiltration (MF). In a broader sense, RO is essentially a dewatering technique, NF is a demineralization process, UF is a method for fractionation and MF is a clarification process. Membrane processes can be carried out at ambient temperature. Thus, thermal degradation problems common to evaporation processes can be avoided resulting in better nutritional and functional properties of milk constituents. The principles involved in the manufacture of some of the traditional dairy products, such as heat desiccation (Khoa, Rabri and Basundi), heat and acid coagulation (Chhana and Paneer) and fermentation and concentration (Dahi, Chakka and Shrikhand) are compatible with that of membrane processing. The membrane processes, therefore, may play a highly beneficial role in modernization and upgradation of the technologies of our traditional dairy products.

29.2 Application of Reverse Osmosis (RO)
RO is the most energy efficient dewatering process. RO membranes separate solutes with a molecular weight of approximately 150 Daltons and above. Hence fat, proteins, lactose and all undissociated minerals are retained and concentrated by the membrane and only water and some ionized minerals are allowed to pass through. Fluid milks and buttermilk can be partially concentrated economically using RO, particularly for the preparation of concentrated and dried products including indigenous dairy products like khoa, chakka, shrikhand, rabri, basundi and kheer. The economical levels of RO concentration for whole milk is up to 30% TS and for skim milk, 22% TS.

29.2.1 Production of khoa by RO process
Khoa, an important indigenous Indian milk product, is presently manufactured on a small scale by continuous boiling of whole milk until a desirable solids concentration (65-70% total solids) is obtained. In recent years, several attempts have been made to develop new methods including the use of scraped surface heat kettles or heat exchangers for commercial production of khoa. The use of concentrated milk having up to 30% TS has produced khoa of highly satisfactory quality. The reverse osmosis, being energy effective process for pre-concentration of milk prior to the manufacture of khoa, has great potential in India. Khoa has been prepared from cow milk as well as buffalo milk by atmospheric boiling of RO retentates in a steam kettle. The process is conveniently amenable to continuous production of khoa from RO milk retentate using SSHE. Such process offers attractive energy saving in the initial concentration of milk. The energy consumption in RO concentration was estimated to about 80 kcal/kg of milk for batch process and 25 kcal for continuous process, which brings about a net saving of 335 to 430 kcal/kg of milk.

29.2.2 Application of RO in other traditional desiccated dairy products
Rabri and basundi are partially concentrated and sweetened traditional milk products. Whereas rabri contains several layers of clotted cream (malai), basundi has either smooth consistency or small grains of coagulated
Traditional Dairy Products

29.2.3 Preparation of dahi and chakka from RO process
Dahi is another important traditional fermented milk product where RO can play an important role. Dahi made from cow milk is weak and fragile in comparison with buffalo product. This problem is due to lower protein and calcium contents in cow milk, which are responsible for firmer curd. Partial concentration of cow milk to about 1.25 to 1.5 folds level by using RO system and preparing dahi from it adopting standard method has been found very useful in producing dahi similar to that buffalo dahi (Pal et al., 2002).

Cow milk, standardized to fat: SNF ratio of 1:2.2 (12.5% TS), was pasteurized and concentrated (2.5 fold) using and RO plant equipped with tubular, polyamide membranes. A temperature of 50°C and a pressure of 30 kg/m2 were used for concentration. The concentrate was subjected to heat treatment of 90°C/5 min, cooled to 22°C, cultured at the rate of 2% with a mixed strain lactic culture and incubated for 18 hours. The coagulum then obtained was filtered and a minimal amount of whey (4.5 lit./40 lit. of coagulum) having 18% TS was removed from it to get the chakka. The yield of chakka produced by RO process was 35.5% as compared to 28.3% in case of conventional chakka.

29.3 Application of Nanofiltration (NF)
Nanofiltration falls between RO and UF as far as pore size of the membrane and operating pressure are concerned. The pore size of NF membrane ranges from 10 Å to 100 Å and operating pressure ranges between 25-30 bars. NF membrane allows water and small univalent ions (Na+, K+, Cl-) to pass through it whereas completely rejects lactose and other macromolecules. Most recently, the NF process has been tried for processing cow milk for improving the quality of traditional dairy products (Pal et al, 2002). The quality of traditional products, particularly khoa, paneer and dahi, is inferior to their counterpart buffalo milk products, which is attributed to inherent compositional differences. Cow milk contains high chloride content, which impart salty taste to these products, particularly khoa. The lower contents of fat, proteins and lactose in cow milk in comparison to buffalo milk are responsible for sandy texture in khoa, hard and very compact body in paneer and weak and fragile gel of dahi in addition to low yields of all products.

Cow milk heated to 72°C and concentrated to about 1.5 and 2.0 folds using NF membrane system at 50°C revealed that, NF reduced the salt content of cow milk up to 74% in 1.5 fold concentration without affecting other major constituents. Khoa prepared from this milk did not taste salty and the texture was comparable to buffalo khoa, thereby improved the acceptability of cow khoa. The organoleptic quality, particularly in respect of body and texture, of dahi also improved significantly when prepared from 1.5 folds NF concentrated cow milk.

29.4 Application of Ultrafiltration (UF)
From milk, UF produces a permeate containing water, lactose, soluble minerals, non-protein nitrogen and water-soluble vitamins. The process has been used for the manufacture of several fermented dairy products like Yoghurt and Srikrhand. UF retentate seems to be a highly promising base for chhana, rasogolla mix powder, long-life paneer. UF technology has also been applied to upgrade khoa manufacture from cow and buffalo
29.4.1 Preparation of chhana using UF process
Skim milk, heated to 95°C for 5 min., is ultrafiltered (26% TS). The retentate is diafiltered (23% TS) with equal amount of water to reduce lactose. For preparation of chhana, the retentate is mixed with plastic cream to a protein/fat ratio of 0.722. The mixture is heated to 85-90°C/5 min. and coagulated with dilute lactic acid to develop the characteristic grain. The granular mass is subsequently pressed to remove free moisture, yielding chhana. The process is reported to yield about 18-19 percent extra product and also no significant difference in flavour, body and texture and appearance compared to traditional method. High yield, easy automation and flexibility in operation are emphasized as advantages of this method for adoption for large-scale production.

29.4.2 Preparation of paneer using UF process
Paneer is a traditional heat-acid coagulated milk product and it is very popular all over India. Typically paneer is white in appearance with spongy body, close knit texture, possessing sweetish-acidic nutty flavour. Paneer manufacture essentially involves heat/acid coagulation of standardized milk followed by pressing of the coagulum. The existing batch manufacturing technique is labour and energy intensive and is susceptible to environmental contamination.

The process developed involves standardization and heating of milk followed by UF whereby lactose, water and some minerals are removed. UF of milk and the removal of permeate is synonymous to removal of whey by coagulation in conventional method. The concentrated mass, which has about 40 per cent total solids, is cold acidified to get the desired pH. Till this point, the product is flowable and can be easily dispensed into containers with automatic dispensing machines. The filled containers are then subjected to texturisation by microwave heating in a domestic microwave oven. This can also be achieved in a continuous process by using microwave tunnels. Such tunnels comprise of a series of magnetrons under which the product moves continuously on the conveyor belts. The resulting product has typical characteristics of normal paneer.

29.4.3 Preparation of shrikhand by UF process
Chakka and Shrikhand of good sensory quality and meeting PFA standards could be successfully prepared using ultrafiltration technology. In standardized ultrafiltration process, Skim milk is fermented with yoghurt culture and it was heated to 60°C for 5 minute with continuous agitation and ultrafiltered up to around 16.60% TS concentration. Whey is then removed from this concentrated coagulum by hanging it in a muslin cloth (eight layered) at room temperature followed by mild pressing to get chakka. Chakka then kneaded in a planetary mixer with 70% fat cream and sugar to prepare Shrikhand of smooth consistency. UF process resulted in nil fat loss in whey and 20.70% extra recovery of total solids in chakka.

29.5 Application of Microfiltration
Microfiltration (MF) is a low pressure membrane separation process for separating colloidal and suspended particles in the range of 0.05-10 microns. MF has been investigated as a competing technology to centrifugation for clarification and bacteria removal of milk and whey. Possible uses of MF include delipidization of whey, shelf life extension of liquid milk, production of cheese with minimal risk of blowing and without nitrate addition, and several biotechnological applications. In case of traditional dairy products there appears to be no direct application of MF, but it can be used to improve the microbiological quality of milk intended for use in the manufacture of traditional dairy products.
Lesson 30

CONVENIENCE FORMULATIONS FOR TRADITIONAL DAIRY PRODUCTS

30.1 Introduction
Consumer convenience along with safety is the key to value addition in dairy and food processing industries. In this context, technology development for process upgradation of certain traditional dairy products is obviously the topical area of research geared to cater to the need of the consumer. Empirical evidences suggest that the composition of an average Indian’s food basket is gradually shifting towards value added products. A survey (February 2006) conducted by the Confederation of Indian Industry also suggests that demand for ready-to-eat foods is growing at the rate of 20%. Some of the Convenience formulations for traditional dairy products are dealt in this chapter.

30.2 Khoa Powder
Khoa powder can be prepared in three different ways. Khoa, made from standardized buffalo milk by traditional method is grated into flakes and subjected to heat treatment to evaporate moisture before grinding in a small scale laboratory grinder. The ground khoa is uniformly distributed over an aluminium tray and dried in a vacuum and atmospheric hot air oven at 70°C. In the second process, grated khoa was dried in a fluid bed drier with an inlet air temperature of 98°C. In the third process, drum drying process is standardized for medium scale operation. Buffalo milk is adjusted to 6 percent fat and 9 percent SNF and heat treated to develop a typical cooked flavour in the final product. The heated and partly concentrated milk is drum dried after adjusting the steam pressure, flow rate of milk and speed of roller drums. Spray drying technology is considered suitable for large scale production of khoa powder. Concentrated milk with 30 percent T.S. is prepared from standardized buffalo milk followed by heat treatment to develop cooked flavour. The heated, concentrated milk was instantly dried in the spray drier with an inlet temperature of 190°C and outlet temperature of 78°C.

On reconstitution with water, this can be utilized directly for the preparation of burfi, milk-cake, kalakand and gulabjamun. Khoa powder packaged in tin containers under nitrogen gas can be stored for up to 10 months at 30°C.

30.3 Rasogolla mix powder
Rasogolla mix powder has been successfully developed employing ultrafiltration process. Cow skim milk is first subjected to ultrafiltration process to attain 3 fold concentration. The retentate contains milk proteins, part of the minerals and lactose as obtained in channa. However excess of the mineral and lactose were removed through diafiltration to make the composition of the retentate identical to chhana. The pasteurized cream is then mixed into diafiltered retentate and subsequently spray dried under standard drying conditions. The dried retentate is blended with selected additives to produce desired flavour and texture.

For manufacture of Rasogolla, an equal quantity of water is mixed to the mix powder and held for about 5 min for rehydration of proteins. The channa dough is shaped into circular balls of about 7 g size in a manner such that no cracks appear on the surface. The balls were first cooked in sugar syrup of 60% concentration for 15 min and later transferred into hot sugar syrup of about 40% concentration.

30.4 Gulabjamun mix powder (GMP)
The Gulabjamun Mix Powder, based on roller dried skim milk powder (SMP), consists of SMP, maida, semolina (suji), hydrogenated vegetable fat, baking powder and cardamom in definite proportions. All the ingredients are dry blended in a power driven mixer such that the ingredients are uniformly mixed. The vegetable fat is added in molten state intermittently to ensure thorough mixing with the dry ingredients. The GMP packaged in laminate pouches and stored in dry place remains acceptable upto 6 months at room
temperature. Process has also been standardized for manufacturing Gulabjamun from the GMP. It generally requires preparation of dough of suitable consistency (50-55 ml water for 100g mix), which could be made into smooth balls of uniform size and shape and deep fat fried in vegetable oil (Dakda) at about 125°C for 15-20 min. The properly fried balls acquire brown colour which are subsequently transferred into hot sugar syrup of 60° brix. Even when SMP and vegetable fat were completely replaced with whole milk powder in the GMP formulation, product characteristics remained largely unchanged. Use of spray dried SMP in place of roller dried SMP was not found acceptable as it led to case hardening of balls during deep fat frying and prevented the sugar syrup penetration thereby resulting in unacceptable product. However certain alterations in the ingredients viz., use of high heat SMP, increase in fat content from 15% in roller SMP based formulation to about 18% in spray based SMP, use of additives such as CMC and sodium citrate and/or addition of dried whey protein concentrates (1-2% of SMP) to the mix, helped in improving the textural properties of the product and resulted in highly acceptable product. However GMP based on spray dried SMP requires certain modifications in manufacturing procedure such as increase in the holding time of dough and frying at slightly lower temperature.

30.5 Instant Kheer mix
Production of Instant Kheer mix involves spray drying of admixture of milk concentrate and rice flour (preheated to partially pre-gelatinize the rice starch) along with sugar followed by fluidized bed drying to make the powder which has excellent reconstitution properties. Rice grains which could be readily rehydrated were obtained by a technology which involved partial cooking of rice, its conversion into a paste, subsequent extrusion and dehydration in air dryer. This form of instant rice was rehydrated in about 5 min. Alternatively, quick cooking rice can also be obtained by drying of partially cooked rice in a fluidized bed dryer. The rice thus obtained could be cooked in hot water in about 10 min.

Spray dried Kheer powder mixed with instant rice is packed in metalized polyester laminates and could be stored at room temperature without any loss of quality for a period of 6 months.

30.6 Instant Kulfi mix
Manufacture of Kulfi mix powder involves preparation of a mix from milk fat (11%), MSNF (16%), sucrose (15%) and isabgol husk (0.2%). The total solids concentration of the mix is adjusted and only 25% of the total sugar required in the final mix is added before drying. The mix is homogenized at 6.83/3.43 MPa, heated at 100°C for 10 min in a tubular heat exchanger followed by cooling to 4°C. The mix is spray dried. The remaining sugar in ground form is dry blended with the powder and packaged in tin cans. The proximate chemical composition of kulfi mix powder is fat 25.41%, MSNF 36.98%, Isabgol 0.46%, Sugar 34.65% and moisture 2.52%. The product has a shelf-life of 7 months at 30°C in tin cans. The shelf-life can be extended up to 10 months with the addition of butylated hydroxy anisole (BHA) and nitrogen gas flushing. Kulfi mix powder can be instantly reconstituted and frozen to get kulfi of consistently good quality all the year round at an affordable price. It ensures the production of pathogens-free frozen product.

30.7 Ready-to-reconstitute rasmalai mix
The process comprised of preparation of syrup mix powder and dehydrated patties to be mixed into an instant rasmalai mix. The syrup mix powder is prepared by dry blending of sweetened milk solids powder, whole milk powder (WMP) and sugar powder. To the dry mix, saffron is added and packed in co-extruded multilayer plastic pouches. The sweetened milk solids powder is prepared from standardized buffalo milk (fat: SNF ratio of 0.35) by heat desiccation. Standardized milk is boiled in a steam-jacketed stainless steel scraped surface heat exchanger to obtain sweetened khoa with a smooth body. The mixture was transferred into a stainless steel tray and allowed to set for 12 h at room temperature. The resulting pat is cut into cubes and dehydrated osmotically to a moisture content of less than 10 percent. The dried cubes were ground into a fine powder.
Fig. 30.1 Preparation of rasmalai syrup using

Dehydrated patty is prepared with cow milk (standardized to fat: SNF ratio of 0.35) chhana. The chhana balls flattened to patty shape were cooked in the syrup and subsequently partially dehydrated by a standardized dehydration technology till the moisture content was less than 10.0 per cent. The dehydrated patties were vacuum packed in co-extruded multilayer plastic pouches.

Fig 30.2 Preparation of ras malai patty using

30.8 Ready-to-reconstitute basundi mix

Ready-to-use Basundi mix is produced using the concept of osmo-air drying and spray drying. The product mix is formulated by dry blending of ingredients like whole milk powder (WMP), sweetened milk solids, particulated whey proteins (PWP) and sugar.

The spray dried WMP is prepared from mixed milk standardized to a fat: SNF ratio of 0.27. The sweetened milk solids (SMS) powder is prepared from standardized buffalo milk (fat: SNF ratio of 0.35) by heat desiccation. Particulated whey protein (PWP) is made by coagulating heated whey and cow milk mixture with a
food grade coagulating agent and subsequently admixing with partially desiccated sweetened milk solids in predetermined proportion. The entire mixture is transferred to a stainless steel tray and allowed to set for 12 h at room temperature. The resulting pat is shredded and air dried to get desired flakes. Dried shreds were packaged separately in co-extruded multilayer plastic pouches.

30.9 Conclusion
A wide variety of traditional dairy delicacies, drawn from different regions of the country, are produced in India using processes such as heat and/or acid coagulation, desiccation and fermentation. Traditional milk sweets and dairy desserts form the large bulk of such products. However, tremendous economic potential of this sector has remained untapped because of the fact that the manufacture of traditional dairy products has remained confined to small level operations, which is manual and energy intensive. Therefore what is needed is adoption of existing unit operations and machines to upgrade and mechanize manufacturing processes of traditional dairy products. The products developed at NDRI, are an attempt in this direction. It is expected that such ready mixes would add convenience to the existing array of customary dishes. Value addition to this effect will not only help in exploiting domestic market-reach of our dairy products but also open new vistas for export to neighbouring countries.

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Module 13. Microbiology of traditional dairy products

Lesson 31

MICROBIOLOGICAL QUALITY AND SAFETY ASPECTS OF TRADITIONAL DAIRY PRODUCTS

31.1 Introduction
Since the production of various indigenous milk products is in the hands of ‘halwais’ (sweet makers) and rural areas, where unhygienic processing conditions are prevalent, the products are grossly contaminated. The contamination results in a considerable increase in the population of spoilage organisms, thereby, lowering the keeping quality of the products. The entry of pathogens which have great significance from the public health point of view is a major issue as the products are consumed by different sections of society including the vulnerable ones.

Dairy scientists have investigated microbiological quality of these products. Efforts are being made to bring improvement in maintaining standards of various indigenous milk products through technological modifications during their production.

31.2 Microbiological Quality of Khoa, Burfi and Peda
Khoa, like other indigenous milk products, can serve as a favourable medium for the growth of a variety of microorganisms due to its high moisture content and good nutritive value. The market khoa usually keeps well for 48 h under usual Indian conditions beyond which it deteriorates due to microbial action. These organisms gain access as contaminants from different sources into product. The rapid spoilage of khoa is attributed to contamination with moulds from external sources. A number of investigations were carried out by different groups of workers on the microbiological status of khoa and khoa based sweets in different parts of the country.

31.2.1 Types of micro flora
Various groups of bacteria (acid producers, proteolytic, chromogenic, lipolytic, aerobic sporeformers, psychrotrophs, thermophiles, pathogens), yeasts and moulds have been reported to occur in khoa.

Psychrotrophic bacteria mainly Pseudomonas, Achromobacter, Flavobacterium and Alcaligenes, have been isolated from peda. On the basis of comparative analysis of khoa, burfi and peda, khoa contained higher population of yeasts and moulds than burfi or peda.

The composite microflora of market burfi and peda was studied in which bacteria, yeasts and moulds were isolated from both the products, though the proportion of yeasts and moulds was extremely low as compared to bacteria. Among the bacteria, Gram-positive (mainly cocci) predominated in both the products.
Table 31.1 Microbial Quality of khoa/chhana/paneer as per FSSA rules

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Khoa Chhana Paneer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total plate count</td>
<td>Not more than 50000/g</td>
</tr>
<tr>
<td>Coliform count</td>
<td>Not more than 90/g</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>Absent in 1 g</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>Absent in 25 g</td>
</tr>
<tr>
<td><em>Shigella</em></td>
<td>Absent in 25 g</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>Not more than 100/g</td>
</tr>
<tr>
<td>Yeast and mould count</td>
<td>Not more than 250/g</td>
</tr>
<tr>
<td>Anaerobic spore count</td>
<td>Absent in 1 g</td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>Absent in 1 g</td>
</tr>
</tbody>
</table>

31.2.2 Microbiological quality of paneer

The microbiological quality of paneer, like other indigenous milk products, chiefly depends on the conditions of manufacture, subsequent handling, storage and sale of the product. The possible sources of contamination might be air, water, utensils, cutting knife, muslin cloth as well as persons handling the product. Hence, the number and types of microorganisms and their distribution in the product may vary depending on the location of the halwai shop, extent of exposure of the product to the atmosphere, temperature and period of storage etc.

According to a survey conducted on the market quality of paneer obtained from Karnal and Delhi samples were found to contain heavy load of total bacterial population, coliforms and yeasts and moulds. Another study on market paneer from Ludhiana city indicated heavy contamination of the product with Staphylococci, 25% of which were found to be positive for coagulase and TDNase.

31.2.3 Microbiological quality of chhana

Chhana samples showed an average bacterial count of $1.6 \times 10^4$ per gram. However, during storage at 37 °C, the count increased to $31 \times 10^6$ and $110 \times 10^6$ at the end of 24 and 48h, respectively. The spoilage of the product was chiefly due to thermoduric bacteria. Among the bacterial types isolated from chhana, micrrococci predominated and constituted 45% of the total microflora, followed by sporeformers (34%). The remaining portion (about 27%) constituted non-sporeforming rod shaped bacteria. Incidence of yeasts and moulds was studied and the initial count of 260 per gram increased to $385 \times 10^3$ per gram on storage for 48 hours. The most commonly occurring moulds in chhana belonged to the genera Penicillium, Aspergillus, Mucor, Rhizopus, Fusarium etc.

31.2.4 Microbiological quality of shrikhand

Analysis of market samples and laboratory made samples indicated that the product was free from coliforms. Quality control test of shrikhand showed not more than $85 \times 10^5$ cfu/g for yeast and mould count and absence of coliforms in 0.1 gram of shrikhand. The contaminants may enter the product during centrifuging / straining or subsequent conversion of chakka to shrikhand or through sugar. However, no food poisoning outbreak has been reported so far due to consumption of shrikhand.
### Table 31.2 Microbial quality shrikhand of as per FSSA rules

<table>
<thead>
<tr>
<th>Characteristics</th>
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</tbody>
</table>

### 31.2.5 Pathogenic organisms from khoa, burfi and peda

A number of pathogens like *Salmonella typhi*, *Shigella dysenteriae*, *Vibrio cholerae* and *E. coli* are able to survive for long periods during storage of khoa. Subsequently, a number of related studies have revealed the occurrence of staphylococci, especially those of heat stable, coagulase positive, enterotoxin producing types in khoa, burfi and peda. Drug resistant coliforms and enteropathogenic *E. coli* have also been isolated from khoa. Although coliforms are heat labile, their isolation from large samples of the product indicates post-processing contamination. The presence of coliforms may also indicate the likely presence of potential pathogens like *Salmonella*, *Shigella* etc. in the product. Contamination of khoa, peda and burfi with *Salmonella schottmuelleri* and *Shigella flexneri* has also been found to correlate with faecal contamination. It was proved that *S. aureus*, a potent food poisoning organism, can multiply in khoa, peda and burfi at the ambient storage temperature as well as at 37 °C.

### 31.3 Spoilage of Indigenous Products by Microorganisms, Control Measures

The constituents of khoa and its sweets facilitate the multiplication of different surviving as well as contaminating micro-organisms, capable of causing the following defects as a result of their growth and activity.

### 31.4 Microbiological Defects in Khoa

#### 31.4.1 Rancidity

On storing khoa under ambient conditions, the fat component is degraded by the action of microbial lipases. Such lipases are produced by certain lipolytic bacteria, yeasts and moulds. Both hydrolytic as well as ketonic rancidity might be produced depending on the nature of microbial activity.

#### 31.4.1.1 Control measures

Storage of khoa under refrigerated conditions (below 10°C) coupled with general hygienic measures during production are advisable.

#### 31.4.2 Stale and sour flavour

These off-flavours are produced mainly due to the activity of proteolytic and acid producing organisms at relatively lower storage temperatures.
31.4.2.1 Control measures
Post-processing contamination especially through unclean utensils, water supply etc. should be minimized.

31.4.3 Mould growth
Storage of Khoa at ambient and also at relatively lower temperatures might favour the growth of moulds which impart off-flavours and may also produce certain mycotoxins under favourable conditions. The mould growth is favoured by the presence of high moisture content in the product, air leakage in the package, high humidity and sufficient aeration in storage room, etc.

31.4.3.1 Control measures
• Since moulds usually enter the product through aerial contamination, proper sanitation through cleaning and fumigation of the dairy environment would control the problem. Apart from this, mould contamination in the product can also be tackled through control of humidity and aeration in the processing and packaging room.
  • The moisture level in khoa should not be allowed to exceed the prescribed limits.
  • Khoa should be stored in air-tight packages.
  • Treatment of wrapping paper with antifungal agents like potassium sorbate controls mould growth. However, use of such chemicals in the product is not permissible.

31.5 Microbial Defects in Paneer / Chhana
Due to high fat and moisture content, these products are prone to microbiological spoilage leading to rancidity (due to fat breakdown) and mouldy surface (due to mould growth). Storage of packaged chhana or paneer at low temperature (5ºC - 10ºC) can check the rancid defect. The mould growth can be avoided by keeping moisture at an optimum level and by avoiding delays in the marketing and disposal of these products.

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